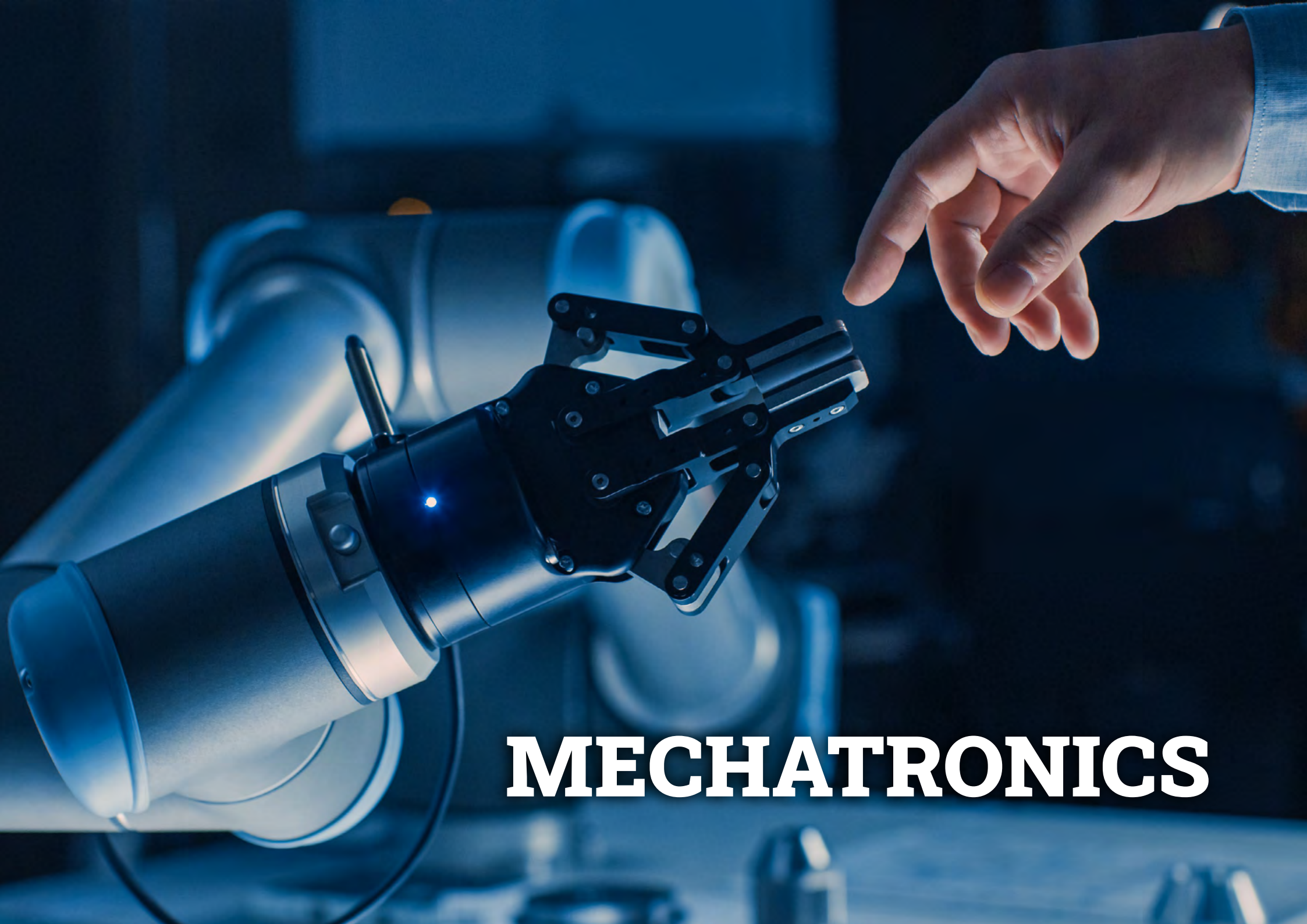

MECHATRONICS

Project name: Mobile laboratories for improvement of STEM knowledge
Project acronym: Lab4Stem,
No. 2020-1-LV01-KA201-077502
Project duration: 27 month,
October 1st 2020 – December 31st 2022

More information ERASMUS+

EML, Federation of Estonian Engineering Industry (Estonia); LINPRA, Lithuanian engineering industries association (Lithuania); Tehnobuss Latvia (Latvia); Vilnius Jeruzalem Labour Market Training centre (Lithuania); Merkuur OÜ (Estonia)

Mechatronics educational material compiled by:
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Translation into English: Kaspar Kütt

Expert feedback on the educational material provided by: Viktor Dremljuga (teacher at Võrumaa Vocational Educational Center)

Lab4STEM

Co-funded by the Erasmus+ Programme of the European Union

Main objectives of the project are:

1) Promotion of pupils' achievements in STEM in attractive way.
2) Strengthening support for educators by open source, interactive, digital training materials about STEM.
3) Strengthening responsibility and involvement of sector business representatives in education process.

Main activities/ results of the project are:

1) Open source, interactive, digital training materials about STEM for pupils in four languages – English, Latvian, Lithuanian and Estonian.
2) Teacher's manual to support educators about usage of interactive, digital training materials in four languages – English, Latvian, Lithuanian and Estonian.
3) Guidelines for sector representatives for improvement of STEM knowledge in four languages – English, Latvian, Lithuanian and Estonian.
4) 3 promotional and testing events for educators about usage of interactive, digital training materials.
5) At least 100 pupils trained in pilot trainings in each country covering all regions of involved countries.
6) National competition of pupils about improvement of training materials
7) 3 project final events.

Contents

Module name: Mechatronics

The purpose of the module, tasks and achievable results, length of module:

Purpose:

the purpose is to give students an overview of the nature and necessity of mechatronics, to understand the developments of technology and to create a connection between the history of technology and the achievements of modern science. To analyze the possibilities and future perspectives of mechatronics, to integrate theoretical materials with practical assignments and solve real-life problems, to introduce possible further learning and career opportunities related to mechatronics, to solve individual/pair/group assignments related to mechatronics.

Tasks/achievable results:

The student:

- Can see and understand natural science and technology connections and express their opinion on the development of technology and the working world.
- Can choose and analyze technical and creative solutions and realize the effects and dangers of them.
- Can choose the right materials, equipment and processing methods to put their ideas into life, also understands the importance of safe and conservative usage of their materials.
- Has an overview of the working opportunities and jobs in the field in the past and present, know the further learning opportunities in the production and processing field.
- Can integrate the field of mechatronics with other learning subjects and areas of life.

The length of the module should be two lessons (4x45 minutes) that include theoretical and interactive assignments + 1 practical hands-on assignment. 4x45 minutes for each module, that can be used in both school lessons and mobile solutions.

Name of learning subject in which module can be used:

technology, career studies, business studies.

THEMES/SUBSECTIONS:

- **General information:**

Definitions, introduction, history, interdisciplinarity, real-life connections. Devices and safety information. Technology and sciences – exciting examples from Estonia and the world. Technology, the human and the environment. The importance and usage of mechatronics and the mechatronic system. The future perspective and innovation of mechatronics.

- **Technical information:**

Mechatronic system and devices (alarms, controllers, acuators, sensors, information networks). Moving types and schemes.

- **Future studies and career information:**

Being a mechatronics engineer, career and learning opportunities, company stories and fields of work.

The purpose of each theme, tasks and achievable results, length of each theme:

I GENERAL INFORMATION:

Purpose:

- To give students an overview of the meaning and necessity of mechatronics.
- To understand the future developments of technology and create connections between the history of technology and modern achievements of science.
- To analyse the possibilities and dangers and future opportunities of mechatronics.
- To integrate the theoretical materials with practical assignments and solve real-life problems.

Achievable results:

The student:

- Can see and understand the connections between natural sciences and the development of technology, can express their opinion on the development of technology and the changing of the working world.
- Can connect mechatronics with other subjects and areas of life.
- Can analyse the possible opportunities and dangers of mechatronics.
- Obtains the knowledge of the importance, usage fields and future perspectives of mechatronics.

II TECHNICAL INFORMATION

Purpose:

- To give students an overview of the types of mechatronics and usage areas: production and machine automation, mechatronics devices and different moving mechanisms.
- To analyse the possibilities and dangers of different types of mechatronics.
- To bind types of mechatronics with other subjects and areas of production and processing.
- To integrate theoretical materials with practical assignments and solve real-life problems.

Achievable results:

The student:

- Can see and understand the connections between natural sciences and the development of technology, can express their opinion on the development of technology and the changing of the working world.
- Can integrate mechatronics with other subjects and areas of life.
- Obtains the knowledge of the importance, usage fields and future perspectives of mechatronics.
- Chooses and analyses technical and creative solutions and the effects and dangers of these.
- Chooses the right materials, equipment and processing methods to put their ideas into life and prioritises the safe and conservative usage of materials.

III FUTURE STUDIES AND CAREER INFORMATION

Purpose:

- To introduce the future studying and career opportunities in the field of mechatronics.
- To emphasize the success stories of Estonian and other companies and describe the mechatronic engineer's role, tasks and importance in modern production fields.
- To integrate the theoretical materials with practical assignments and solve real-life problems.

Achievable results:

The student:

- Can see and understand the connections between natural sciences and the development of technology, can express their opinion on the development of technology and the changing of the working world.
- Can integrate mechatronics with other subjects and areas of life.
- Has an overview of the possible jobs related to mechatronics in the past and present, knows the future learning opportunities regarding production and processing.

PART I

General information

The name **mechatronics** consists of three parts: **mechanics, electronics and informatics.** The three parts of the name are mecha(nics) + (elec)tron(ics) + (informat)ics. This means that mechatronics is a science based on the cooperation of mechanics, electronics and computers.

- **'mechanics'** means the mechanical components of the system, their assembly, connection and maintenance, and manual activity in the use of these parts;
- **electronics** - the construction and testing of schemes;
- **informatics** - software installation, program loading, tuning, and information visualization.

What is Mechatronics?

Mechatronics Design

History and background

Mechatronics is a term initiated by the Japanese to describe the integration of mechanical and electronic engineering. Specifically, it refers to the automation of machines, introducing computers and other electronic devices for the development of a system that offers new features and capabilities at a more accurate and lower price.

Mechatronics began to be used in Japan in the 1960s, and this area has indeed supposedly grown from robotics. Early on, robotic arms were uncoordinated and had no sensory feedback, but as advances were made in programming, sensor technology, and control, robotic movements became more coordinated.

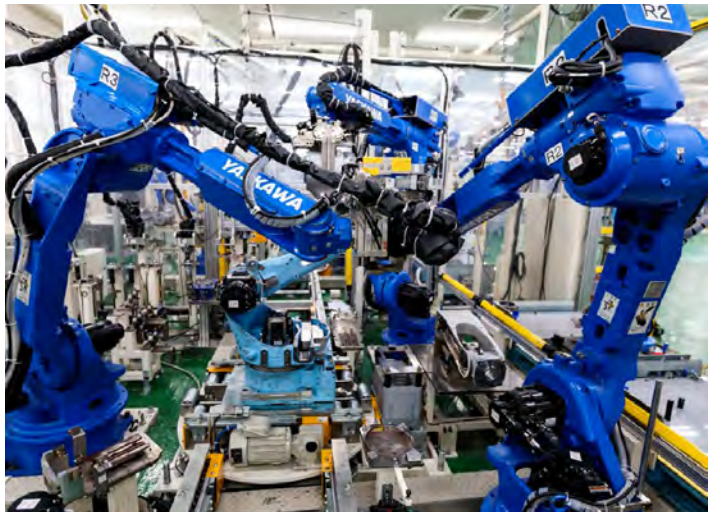
The name "mechatronics" was coined in 1969 by senior engineer Tetsura Mori. He worked for a Japanese company called **Yaskawa Electric Corporation**, famous for the construction of mechanical equipment for the plant. At that time, Yaskawa Electric Corporation used some electronic functions to produce mechanical devices. Mori wanted to adopt a technical term for this new technology, so he combined two technical words "mechanical" and "electronics" and coined a new word for "mechatronics."

Tetsuro Mori

Japanese company Yaskawa

Yaskawa Electric Corporation is a Japanese manufacturer of servo motors, motion controllers, AC engine drives, switches and industrial robots. Their Motoman robots are used, for example, in welding, packing, assembly and cutting.

YASKAWA



Yaskawa Electric Corporation

Before the 1970s, most industrial products and equipment, such as machine tools, production equipment and home appliances, were mainly based on mechanical principles with very few electrical and electronic properties. **However, after the seventies, the technology of these products changed and the increasing content of the electrical and electronic system integrated with the mechanical parts of the products changed.**

If previously this term was based only on some electrical and electronic computers, then after the **1980s** the use of computer technology was integrated. Controlling and operating machines became much easier with the help of computer hardware and software. This made it possible to start making products of any size with very high accuracy and relatively low cost.

Along the way, advances in mechatronics began to be used in vending machines, autofocus cameras and door openers. With the advent of information technology in the 1980s, microprocessors were introduced into mechanical systems, significantly improving performance. **By the 1990s, mechatronics implemented advances in computational intelligence in a way that made this field groundbreaking.**

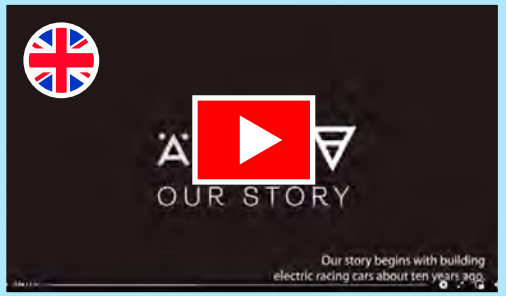
Mechatronics originally combined mechanics and electronics, but as the years passed, computers increased in importance, and as a result, computers began to be used more in this field. In addition to computer systems, microsystems and telecommunications systems are also involved in mechatronics. New technologies are becoming increasingly self-thinking. Newer mechatronic devices already use nanoelectronics, which is capable of analysing measurement results themselves and operating on the basis of information from other parts of the system.

Today, machines and equipment are becoming increasingly modern and technically complex, which is why they need workers trained to use these devices as safely and optimally as possible. **Mechatronics is one of the youngest and fastest growing technical trends in Estonia and the rest of the world, which is based on modern product development and adds not only thorough mechanical knowledge but also knowledge of information technology and electronic equipment.**

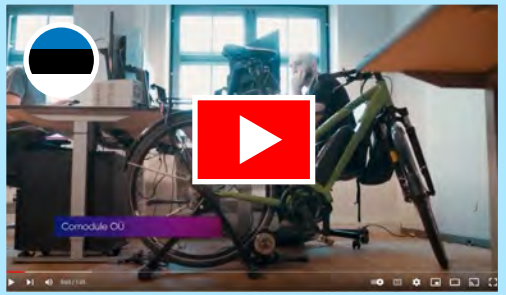
Comodule AS (Estonia)

Comodule is one of the world's leading developers of micromobility, producing both Internet of Things (IoT) modules/solutions that enable the management of sharing economy systems and the world's greenest electric scooters under the Wind and Thunder brands.

Website: comodule.com



Äike – Our Story



Comodule – Innovator of the Year 2019 award nominee

Comodule at Unicorn59

Cleveron AS (Estonia)

Cleveron is the world innovation leader in creating robotic parcel machines and last mile click and collectsolutions for the retail and logisticssectors. Cleveron's products include Cleveron 301 and 302 parcel machines, Cleveron 401, the world's first proven reliability parcel robot, and cleveron 402, the world's largest intelligent robotic parcel terminal.

Website: cleveron.com

Cleveron 302 parcel machine

Cleveron 402 – self-service pickup point for click and collect orders

Cleveron – Company of the Year/Innovator of the Year 20218

Cleveron – your partner for last mile delivery automation

Threod Systems

Estonian unmanned aircraft manufacturer.

Website: threod.com

The EOS C is a high-performance electric VTOL mini-UAV with best-in-class air performance and many uniquefeatures.

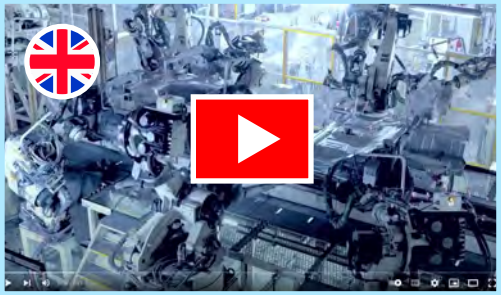
EOS C VTOL high altitude flight

War barrel – Threod Systems

Threod Systems EOS VTOL

Videos introducing the activities of various international production companies

Mechatronic manufacturing – KEBA Industrial Automation Germany



Industry 4.0: Robotics and automation

The Industry 4.0 with Siemens

Inside Amazon's Smart Warehouse

Inside The Ice Cream Factory

Lego Bricks In The Making

2021 Tesla Model Y Production Line at Giga Shanghai Phase II, China

PART II

Technical information

Mechatronics is all around us. Today, practically all mechanical devices contain electronic components and can be computerized and controlled. Examples of mechatronic systems include many different devices and systems: for example, the air traffic control and navigation system of the aircraft, the safety system of the car's airbags and the anti-blocking braking systems, automated production equipment (including robots, numerically controlled machine tools), smart kitchen and household appliances and toys.

Air traffic control and navigation systems

Safety system for car airbags safety pads

Automatic welding robot Yaskawa

Toys

Numerically controlled CNC lathe

Smart kitchen and household appliances

Smart washing machine

Floor washing robot

Window cleaner Robot

Robot mower

Moley kitchen robot

Moley Cooking Highlights

Automate - to make it automatic or self-working.

For example, automated home appliances can be semi- or fully automated. A fully automatic device performs tasks without additional human intervention (e.g. smoke detector) and the semi-automatic device must be set up in advance, and then the machine is able to operate according to the program (e.g. washing machine) without human intervention.

The goal of mechatronics is to improve the capabilities of technical systems and create equipment that will work on new principles. Mechatronics systems have made it easier to design and model products and processes, and it is also possible to configure machines faster in production and better manage production processes.

The mechatronics system is a combined, co-functioning complete device of mechanical, electronic and INFORMATION technology systems.

The mechatronics system consists mostly of sensors, actuators and the software that conducts them. Sensors obtain different types of information from the environment around the device or from the device itself and transmit it to the control module, which is usually the controller. According to the program and the information received from the sensors, the controller controls the actuator mechanisms, which in turn create movement and thereby affect the external environment.

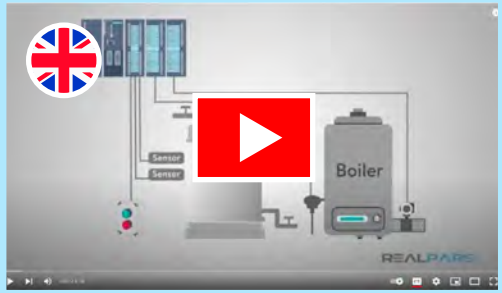
A sensor is a device that converts a mostly measurable physical or chemical size into another size (signal) that is better amplified, measured, transmitted or processed.

There are two main types of sensors:

1. **An active sensor** converts one type of energy into another without an external energy source or incentive;
2. **The passive sensor** cannot directly convert energy, but it controls the stimulus energy that comes from another source.

Sensors are divided into classes according to the purpose of the application, such as pressure and force sensors, speed sensors, vibration sensors, temperature sensors, humidity sensors, gas sensors.

What is sensor?



Types of sensors

Examples and uses of different sensors:

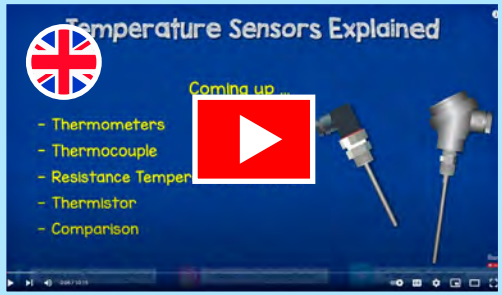
- **a smoke detector** is a fire detector that reacts to soot particles contained in combustion smoke;

The construction and principle of operation of the automatic optical smoke detector

- **the temperature sensor** digitally measures the temperature (e.g. used in the food industry);

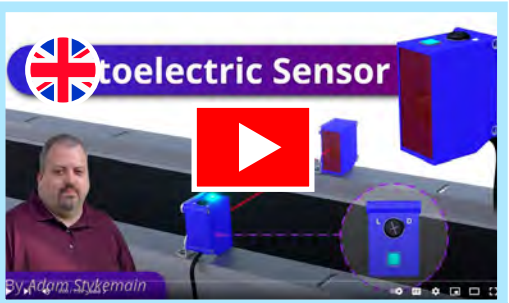
How Do Smoke Detector Work

Temperature sensor



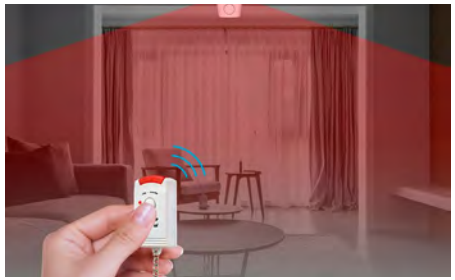
Temperature Sensors Explained

- **photoelectric sensor** measures the strength of light (e.g. used in surveillance equipment);



Photoelectric Sensor Explained

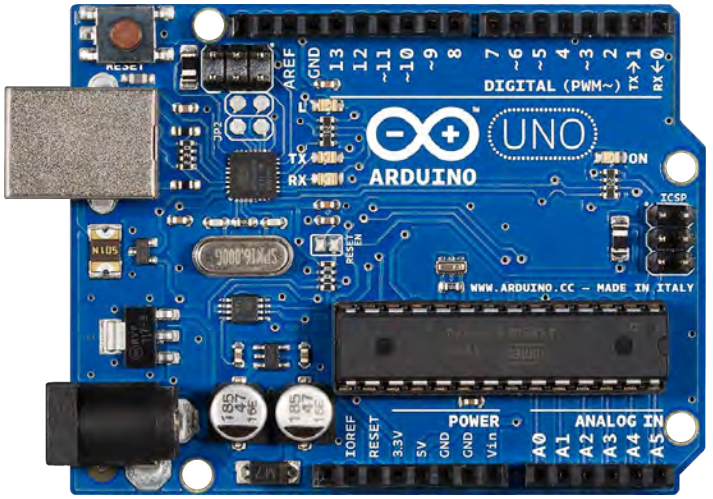
- **infrared beam** detects movement through a barrier (e.g. used in surveillance and security devices).



How PIR Sensor Works and How To Use It with Arduino

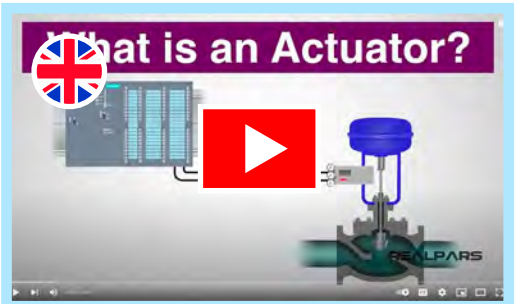
A controller is a special computer that is used to control machines and processes according to a previously prepared program. In the controller, the processing of information and the transmission of commands to the actuator take place. The controller allows the use of the following: on and off control, timer, counter, comparison, arithmetic operations and data processing. Every automated system or machine has a controller.

Controllers can be divided into **pneumatic, hydraulic, electrical** and **electronic** according to the technology used. There is also a distinction between hardware and software programmable controllers. **A programmable controller** (PLC, programmable Logic Controllers) is a universal controller with which tasks of a system or equipment can be automatically controlled and performed in a logical order. PLC refers to a computer that is associated with sensors and actuators of a working machine and developed for specific types of control tasks. Simple PLC consists of power, central controland signal-modules.



Arduino UNO Microcontroller

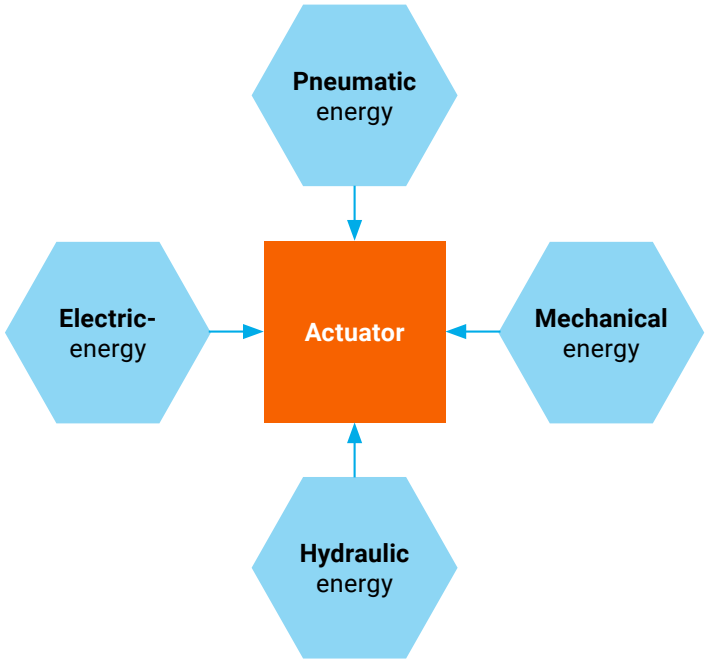
The actuator is a part of the automatic control system that, according to the signal received from the regulator, affects the controlled process. Most often, the actuator acts as a drive that converts electrical, hydraulic or pneumatic energy into the required movement. The actuator can be an electric drive, a hydraulic drive or a pneumatic motor. Actuators are categorized by the type of forces their drives use.



What is an Actuator?

There are four types of force:

- electric,
- pneumatic,
- hydraulic,
- mechanical.

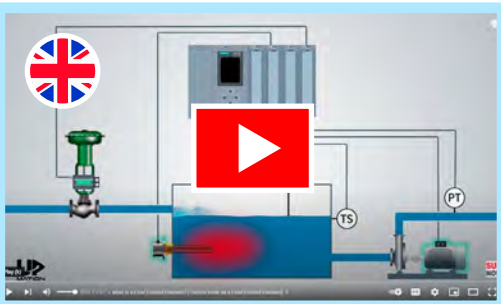


- **The electric actuator** converts electricity (e.g. used to open and close the valves).

Electric Actuator

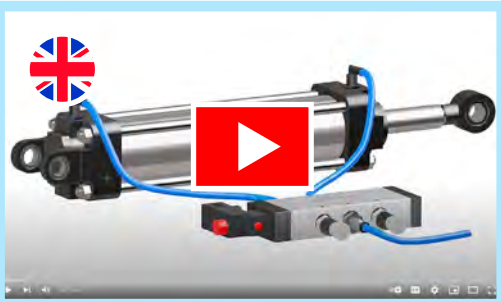
CNC device

- **Pneumatic actuators** use gas for operation, and the actuator is usually a pneumatic cylinder (e.g. used when opening and closing the doors of regular buses). The cheapest gas used is ordinary air.

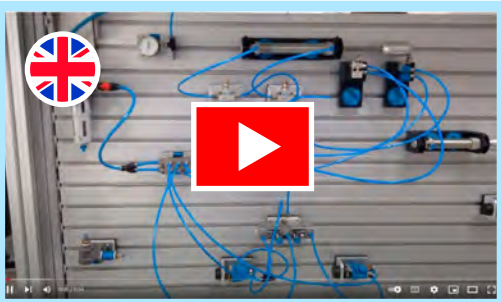


How Pneumatic Control Valve works

Pneumatic riveting machine



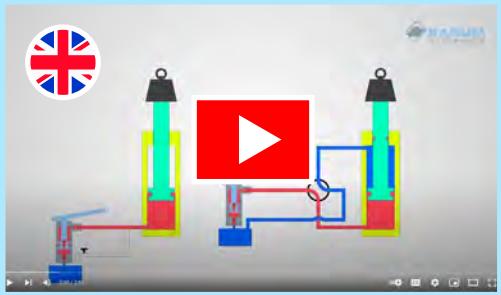
Pneumatic Cylinder Working Explained



Festo Basic Pneumatic Function

- **The hydraulic actuator** is a hydraulic device (e.g. used in the braking systems of passenger cars). Force is applied to one end of the device, and this force is transferred to the other end, using a liquid that cannot be compressed.

How do Hydraulic Actuators work?


Single Acting and Double Acting Hydraulic cylinders. What's the difference?

Electro Hydraulic Actuator for Control Valve Automation

Hydraulic guillotine with a rocking beam, used to cut narrow or wide, thin or paku sheet metal.

- **The mechanical actuator** performs mechanical work using external energy (e.g. used to open and close external doors and automatic garden gates). The mechanical force received is either circular or straight-line.


Passenger car wiper engine (mechanical snail transfer)

PART III

Further education and career information

Mechatronics build and test or service mechatronic systems. They are engaged in the review of the process and organise the supervision of mechatronic systems in various areas of use

The main task of the mechatronic is the assembly, use and testing of mechatronic devices and systems. The mechatronic must tune different mechatronic devices, he must use appropriate measuring instruments to tune them. The mechatronic must make sure that the systems and equipment he has assembled work well and without failure.

The mechatronics draws up programs for those controllers that control the operation of automatic lines so that they regulate the sensors on the line. For example, the sensor signals information to the robot about when one or another detail on the line will reach a position. **The lower-level mechatronic must also be able to change the sensor and line drive in an automatic technology device or line and adjust the operation of the line engines.** He must also be able to create simpler programs on the computer to control such automatic lines.

Find your occupation: mechatronic


Mechatronics, it is a breeze (Tallinn Industrial Education Centre)


Why study mechatronics (Tallinn University of Technology)

If an automatic device stops, the mechatronic must be able to understand what caused the failure and find the most suitable solution to fix it. In the event that he cannot fix it himself, he will have to decide which specialist additional help may be needed to eliminate the problem. **The mechatronic must be able to identify the cause of the problem and determine the path of its elimination to an electrician, information engineer or mechanic.**

Mechatronics is interested in knowledge of mechanics, electricity and automation and computer science. He must know the elements of mechatronics systems and their markings, be able to design and test mechatronic systems, know the construction of working and measuring instruments, principles of operation and know how to use and maintain them. **Work requires knowledge of production processes and the ability to subtract them into sub-processes, the structure of control systems, the principles of information processing and transmission, and the transformation of signals.** The ability to read and mediate technical documentation is required.

Fundamentals of electrical engineering and electronics (TUT)


Why come to study Electroenergetics and Mechatronics (TUT)


What do students of electrical engineering and mechatronics think about their major? (TUT)

Also, the mechatronic must know the safety of the working environment and the basics of customer service. Leadership skills are important for a mechatronic working at the level of a technician, who may have 2-3 subordinates. Knowledge of foreign languages is necessary, as there are very few estonian-language professional literature and study materials. English, German and Russian are the most important foreign languages.

The profession of a mechatronic requires spatial imagination, generalization ability, logical and systemic thinking and interest in technology. Personal characteristics benefit from an advanced sense of responsibility and duty, self-discipline and a willingness to cooperate and communicate. An introverted person with a very closed nature cannot work as a mechatronic. Since there are many areas intertwined in professional activities, he must be able to formulate problems and questions accurately, which also requires good communication skills.

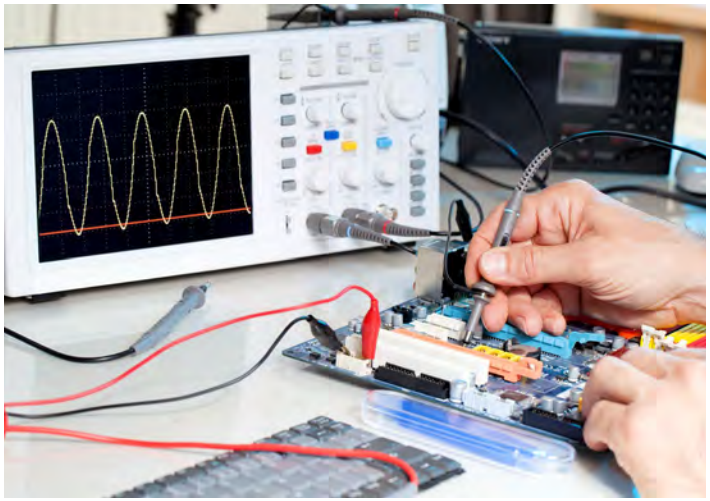
Come and learn electroenergetics and mechatronics! (TUT)

Get to know the curriculum - TUT Electroenergetics and Mechatronics!

From TUT to a valued specialist of a world-class top company

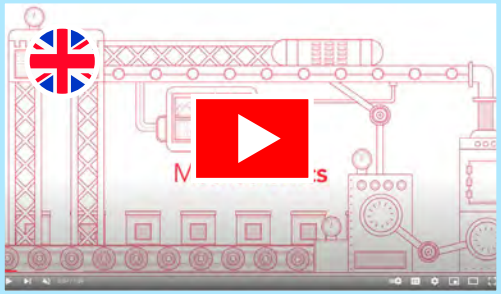
The mechatronics makes the machine ready and keeps it running so that someone else can work on it. It programs and sets up industrial lines or robots to perform the necessary commands and perform the prescribed activities.

Mechatronics work in workshops equipped with the corresponding device (automatic lines equipped with robots, etc.), which must be clean and tidy and have very good lighting and ventilation. Various measuring and tools (tester, ossiscope, length measuring instruments, measuring clocks, temperature sensors) and other aids must be used in the work. For the work of a mechatronic, special clothes are not necessary, rather, it is important that the clothing is comfortable and allows for various activities.

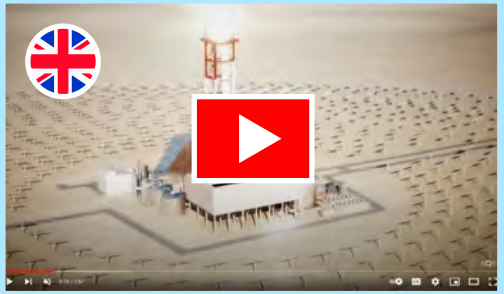


What is Mechatronics

Mechatronics – Build Whatever You Want



Skills Discovery: Mechatronics

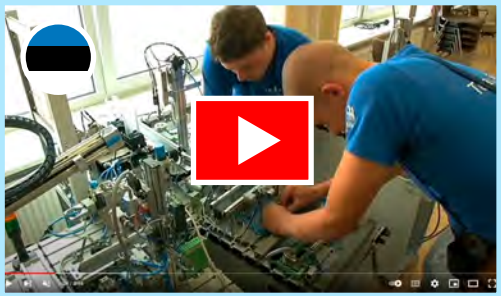


Career Spotlight: Mechatronics Engineer

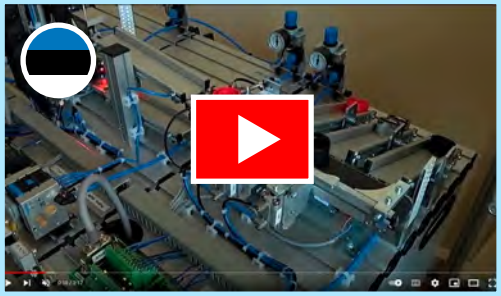
What's it like to be a Mechatronic Engineer?

What are the skills needed to be a good mechatronic engineer

The EuroSkills, which aims to introduce different professions and develop vocational training in Europe, will be organised across Europe. EuroSkills competitions can be both individual and team,with young people up to the age of 25 getting tested in about fifty events. Mechatronics is also one of the areas represented at the EuroSkills professional championships, and several students of Estonian vocational schools have been able to test their skills among vocational students in the same field in Europe.



WorldSkills 20215: mehhatroonika võistlejad Roland Roman Puiestik ja Johan Arus



WorldSkills 2017 Team Estonia: mehhatroonikud Jürgen ja Arnold

What are the futureskills andareas?
I PROFESSIONAL CHAMBER / OSKA

On the study of mechatronics and the prospects for the future

Learning in technical fields could be more popular around the world, as everything is increasingly related to technology. However, a strong background in the sciences is a major challenge for many. In order to make it easier for young people to study technical sciences, it would be important to integrate **STEM learning** already at the basic level (S - science, T - technology, E - engineering, M - mathematics), which helps to learn to combine science and technique through practical experience.

Mechatronics is very closely related to automation, robotics and IT, so there are similar curricula in both vocational and higher education. With a view to future career and self-development in the technical field, you should definitely plan with **continuous further training**, because the rapid developments and competitiveness in this field depend on keeping you informed.

In addition, separate professional certificates are issued by the Estonian Machinery Industry Association. It is possible to apply for **Mechatronics, Level 4** or **Mechatronic Technician, Level 5**.

Mechatronics can be studied in Estonia at the following levels of education:

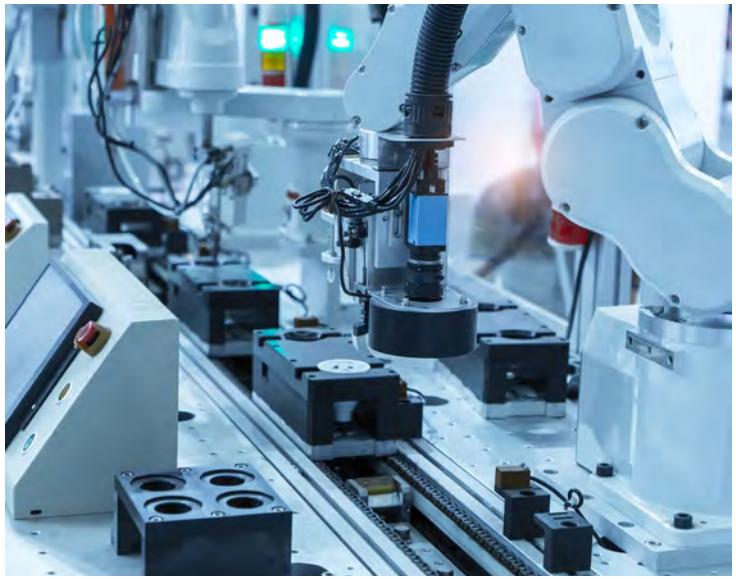
Higher education:

- Tallinn University of Technology
- Estonian University of Life Sciences

Vocational training:

- Tallinn Industrial Education Centre
- Tallinn Polytechnic Shool
- Tartu Vocational Education Centre
- Võru County Vocational Education Centre
- Ida-Viru County Vocational Education Centre

Also, by occupation, people with a background in mechatronics can work in positions with very different names depending on the specifics and job description of the company. **The development of the industry has led to a exponentially greater need for automation, digitalisation and robotisation in companies,** which makes it important to learn and improve such skills and competences for life. Many companies offer internships and do separate events to recruit tech talent early on in their companies and make job offers.



The largest employers in the field:

- Eesti Energia
- Elektrilevi
- Elering
- Harju Elekter
- Ericsson Eesti AS
- Cleveron
- ABB

Source: TALTECH

But also many small and medium-sized engineering firms and manufacturing companies, such as

- Tech Group
  Industrial engineering, machine building and factory automation
- Hoob OÜ HOOB
  Factory Automation and Machine Building
- Insero OÜ Insero
  Mechanical engineering and design development
- Milrem Home
  Innovative robotics solutions for challenging environments
- Auve Tech Auve Tech
  Autonomous vehicles and smart transportation systems.

For example, in 2019, Cleveron Academy was established in cooperation with the technology company Cleveron and the Estonian Entrepreneurship University of Applied Sciences to provide applied higher education in the field of robotics software development.

Formula Student is a product development competition aimed mainly at technical science students, which was first held in Estonia in 2006. The Formula Student Tallinn team consists of students from Tallinn University of Technology and Tallinn University of Technology. The idea for the competition comes from the United States, where university teams under the auspices of Formula SAE have been measuring apart for nearly three decades. Over the past decade, Formula Student/SAE has gained more and more popularity and spread all over the world. They have been competing in Europe since 1998, and Formula Student has also reached Japan, Australia and Brazil.

Formula Student is a design, construction and later introduction of a **single-seat formula car**, passing various tests and racing on the circuit. Participating in the project gives the student real experience in the design and manufacture of the car and introduces the economic side of the automotive industry to the young engineer.

Formula Student Team Tallinn 2021

What does the student form do?

Pneumobiil Technics 5 is a **compressed air formula** developed by the Society of Technical Students, the design of which draws inspiration from the prototype machines competing at Le Mans.

Pneumobiil T5 is distinguished by the widespread use of 3D printing technology – many of the engine and chassis details are made of stainless steel and aluminum using the SLS method. The machine's aluminum pipe frame skeleton is covered with plastic body panels made with FDM technology. The Technics 5 compressed air formula is made smart by National Instruments' cRIO industrial computer, which allows real-time monitoring, altering and analysis of processes occurring in themachine.

EST Pneumobil 2018 – Technics 4

Questions

Multiple choice (select one or more answers)

1. **Which disciplines are mechatronics made up of? Choose one or more answers:**

   A. informatics
   B. logistics
   C. mechanics
   D. electronics

2. **When was the concept of mechatronics introduced? Choose one answer:**

   A. 1918
   B. 1945
   C. 1957
   D. 1969

3. **Which Estonian company is the world's innovation leader in the development of robotic parcel machines for the retail and logistics sector? Choose one answer:**

   A. Comodule OÜ
   B. Cleveron AS
   C. Threod Systems
   D. ABB

4. **Which parts are mostly mechatronics systems? Choose one or more answers:**

   A. leading software
   B. sensors
   C. actuators
   D. engines

5. **What does a photoelectric sensor measure? Choose one answer:**

   A. detects movement through the barrier
   B. measures temperature digitally
   C. measures the strength of light
   D. reacts to soot particles contained in combustion smoke

6. **What does the smoke detector react to? Choose one or more answers:**

   A. movement
   B. soot particles contained in smoke
   C. temperature
   D. to light

7. **What is the name of a special computer that is used to control machines and processes according to a previously drafted program? Choose oneanswer:**

   A. acuator
   B. active sensor
   C. passive sensor
   D. controller

8. **What are the devices that convert a measurable physical or chemical size into another size that is better amplified, measured, transmitted or processed? Choose one or more answers:**

   A. passport holders
   B. activators
   C. actuators
   D. controllers

9. **What is the part of the automatic control system that, according to the signal received from the regulator, affects the controlled process? Select one answer:**

   A. sensor
   B. acuator
   C. controller
   D. regulator

10. **What types of force are used by actuator drives? Choose one or more answers:**

    A. hydraulic
    B. pneumatic
    C. mechanical
    D. electric

11. **What are the names of actuators that use gas to operate? Choose one answer:**

    A. electric actuator
    B. hydraulic actuator
    C. pneumatic actuator
    D. mechanical actuator

12. **What is the name of a universal controller with which the tasks of a system or equipment can be automatically controlled and performed in a logical order? Choose one answer:**

    A. PLC
    B. CNC
    C. NC
    D. VC

Choose the right or wrong answer

13. **The name “mechatronics” was invented by Tetsura Mori, senior engineer of the Japanese company Yaskawa Electric Corporation.**

    Choose: right/wrong

14. **To automate means to be automatic or self-working.**

    Choose: right/wrong

15. **A passive sensor converts one type of energy into another without an external energy source or incentive.**

    Choose: right/wrong

16. **The controller is carried out by processing information and forwarding commands to the actuator.**

    Choose: right/wrong

17. **The sensor is the part of the automatic control system that, according to the signal received from the regulator, affects the controlled process.**

    Choose: right/wrong

18. **Sensors obtain different types of information from the environment surrounding the device or from the device itself and transmit it to the control module, which is usually the controller.**

    Choose: right/wrong

19. **The main task of a mechatronics is the compilation, use and testing of mechatronic devices and systems.**

    Choose: right/wrong

20. **Knowledge in mechanics, electricity and automation and informatics is not important for mechatronics.**

    Choose: right/wrong

21. **Mechatronics does not need to know the safety of the working environment and the basics of customer service.**

    Choose: right/wrong

22. **The development of industry has led to a exponentially greater need for automation, digitalisation and robotisation in companies, which makes it important to learn and improve such skills and competences for life.**

    Choose: right/wrong

Right answers

1. A, C; D

2. D

3. B

4. A, B, C

5. C

6. B

7. D

8. A, B

9. B

10. A, B, C, D

11. C

12. A

13. right

14. right

15. wrong

16. right

17. wrong

18. right

19. right

20. wrong

21. wrong

22. right

Practical tasks

1. Project

„Build a line robot“

Tasks:

1. Familiarize yourself with the installation of electronic components on a printed circuit board.
2. Familiarize yourself with the symbols of electrical diagrams and electronic components.
3. Familiarize yourself with the working principles of various electronic components.
4. Measure the resistance of resistors with a multimeter or determine resistor values based on color codes.
5. Practice soldering elements to a printed circuit board.
6. Design and build a functional line tracking robot.

Tools:

- soldering station,
- tin pump or tin sock,
- safety glasses,
- j waiting aid with magnifying glass (third hand),
- multimeter,
- Phillips screwdriver,
- pliers,
- cutting pliers.

Materials:

- electronic kit „D2-1 Intelligent Tracking Car DIY Kits“,
- battery AA (2pcs),
- solderer.

2. Project

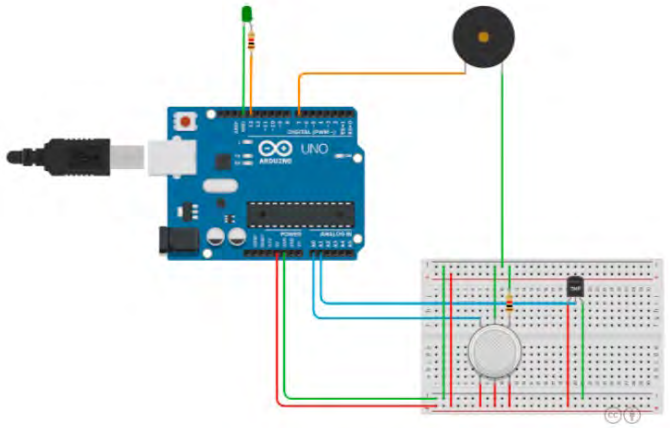
„Fire alarm system in Tinkercad environment“

Tasks:

1. Using Tinkercad environment to build a finished Arduino controlled a fire alarm system that uses a temperature and smoke detector.
2. Program the microcontroller Arduino UNO.

Tools:

- simulation software Tinkercad,
- computer with internet connection.

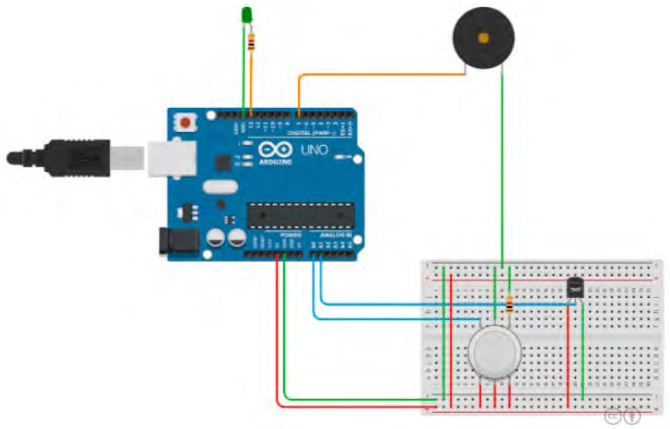


3. Project

„Fire alarm system with physical components“

Tasks:

1. Using physical components to build a finished Arduino controlled a fire alarm system that uses a temperature and smoke detector.
2. Program the microcontroller Arduino UNO.



Tools:

- computer with pre-installed Arduino IDE 1.8.19,
- multimeter,
- Arduino UNO microcontroller,
- LM-35 Temperature senso,
- gas sensor MQ2,
- resistors 1k Ohm,
- layout board,
- LED,
- Piezo-Summer,
- connection wires.

4. Project

„Bionic fish“

Tasks:

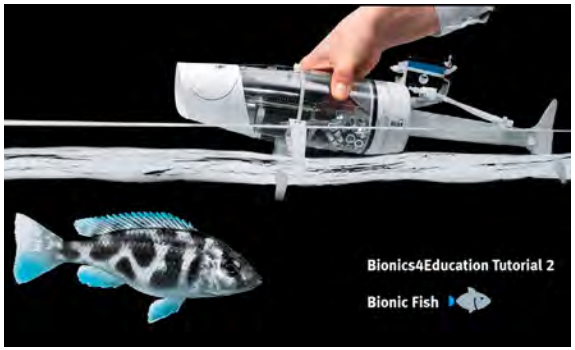
1. Get to know the field of BIONICS.
2. Design a head, fins and tail for a fish and test different solutions in real life Environments.
3. Familiarize yourself with the working principles of various electronic components.
4. Practice fine motor skills.
5. Build a ready bionic fish.

Tools:

- Festo educational set „Bionics4Education“,
- AA batteries (4 pcs.),
- tablet or smartphone,
- water bath for bathing fish,
- scissors.

Additional equipment:

- water to fill the water bath.




Festo – Bionics4Education


Bionics4education (Merkuur OÜ)

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