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АНГЛИЙСКИЙ ЯЗЫК

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ЗАДАНИЯ ДЛЯ ОБУЧЕНИЯ ПРОФЕССИОНАЛЬНО ОРИЕНТИРОВАННОМУ ЧТЕНИЮ НА АНГЛИЙСКОМ ЯЗЫКЕ

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Unit 1. Robotics

1. Read the text. Write out the key terms related to the topic.

Robotics is the interdisciplinary branch of engineering and science that includes mechanical engineering, electrical engineering, computer science, and others. Robotics deals with the design, construction, operation, and use of robots as well as computer systems for their control, sensory feedback, and information processing.

These technologies are used to develop machines that can substitute for humans. Robots can be used in any situation and for any purpose, but today many are used in dangerous environments (including bomb detection and de-activation), manufacturing processes, or where humans cannot survive. Robots can take on any form but some are made to resemble humans in appearance. This is said to help in the acceptance of a robot in certain replicative behaviors usually performed by people. Such robots attempt to replicate walking, lifting, speech, cognition, and basically anything a human can do. Many of today's robots are inspired by nature, contributing to the field of bio-inspired robotics.

The concept of creating machines that can operate autonomously dates back to classical times, but research into the functionality and potential uses of robots did not grow substantially until the 20th century Throughout history it has been frequently assumed that robots will one day be able to mimic human behavior and manage tasks in a human-like fashion. Today, robotics is a rapidly growing field, as technological advances continue; researching, designing, and building new robots serve various practical purposes, whether domestically, commercially, or militarily.

Many robots are built to do jobs that are hazardous to people such as defusing bombs, finding survivors in unstable ruins, and exploring mines and shipwrecks. Robotics is also used in STEM (Science, Technology, Engineering, and Mathematics) as a teaching aid.

2. Complete the sentences with the following word combinations:

deals with, substitute for humans, in appearance, contributing to, human behavior, a rapidly growing field.

1. Robotics … the design, construction, operation, and use of robots as well as computer systems for their control, sensory feedback, and information processing.
2. These technologies are used to develop machines that can … .
3. Robots can take on any form but some are made to resemble humans … .
4. Many of today's robots are inspired by nature, … the field of bio-inspired robotics.
5. Throughout history, it has been frequently assumed that robots will one day be able to mimic … and manage tasks in a human – like fashion.
6. Today, robotics is …, as technological advances continue; researching, designing, and building new robots serve various practical purposes, whether domestically, commercially, or militarily.

3. Practice reading of the following words and translate them into Russian, consult a dictionary if necessary:

interdisciplinary, sensory feedback, bio-inspired robotics, inspired by nature, frequently assumed, domestically, hazardous to people, teaching aid.

4. Discuss the following facts with a partner.

1. Some people fear that robots will eventually take over the world because they will become their own species.
2. Japan's NES System Technologies recently built a winebot, capable of identifying many different types of wines and cheeses. It made a mistake at one point and named a reporter's hand as prosciutto.

Unit 2. Robot history

1. Read this text attentively and learn some facts from robot history.

Although the development of robots seems a very modern idea, the principles behind this new technology were known thousands of years ago. Even ancient Greeks and Romans used mechanical cogs and gears which are now an essential part of robot technology. In the Middle Ages there was a real breakthrough in the development of robot engineering. At that time many types of mechanical devices appeared. At the end of the 17th century engineers already knew about most of the mechanical components that make up a modern robot.

Throughout history inventors have produced a variety of seemingly magical mechanical devices capable of quite life-like actions. These devices were not programmable, they were simply performing a set of operations. Different scientists and engineers have applied many advances in this field since that time.

Today's robot is a very complex structure. A metal or plastic frame serves for a skeleton, and a variety of actuators provide muscle power. But the new humanoids are not just bodies, they are also sophisticated sensing machines with cameras, microphones, even specific sensors that imitate the sense of touch. And then there are the brains. Nowadays scientists haven't yet created such a robot that can think. But who knows, maybe in the future it will not only resemble a human being in appearance but will also have the capacity to think and feel.

2. Complete the sentences according to the text.

1. Today the students ... some facts about ... history.
2. Ancient Greeks and Romans used ... cogs and gears which are now an ... part of ... .
3. At the end of the 17th century engineers already knew about most of the ... that ... a modern robot.
4. Throughout history ... have ... a variety of seemingly magical ... devices.

5. These devices were simply ... a ... of operations.
6. A robot consists of a metal or plastic ... and a variety of ... provide muscle ... .
7. Today's robots are sophisticated ... machines that have ..., microphones and specific ... that imitate the ... of ... .

3. Expand these sentences with the facts from the text.

1. The basic principles of robot technology were known thousands of years ago.
2. The Middle Ages produced advances in robot technology.
3. There were many mechanical devices in the past.
4. A modern robot is a complex engineering structure.
5. It's difficult to predict what the robots of the future will look like.

4. Discuss the following facts with a partner.

1. The first working robot made cars as a part of a production line at car giant, Ford in 1961.
2. The smallest robot is called a nanobot. It is less than one-thousandth of a millimeter.

Unit 3. Robots and men

1. Look at these questions and read the text to find the answers.

1. How did the invention of the robot affect the man?
2. What system directs the manipulator's actions?
3. What did the robot do after the manipulator had finished all the operations?
4. Did the students enjoy the work of the robot?

Man widened his possibilities and relieved himself from monotonous and hazardous tasks after he had invented the robot. Nowadays there's an endless variety of robots in the size, shape and jobs they perform. Scientists and engineers devise robots both for industry and homes. Some of the robots are experimental and look more like living creatures. Many people are working today in the field of robotics and they are trying to find new applications for robots in the future.

Now let's have a look at some students of Technical University that study robotics. Yesterday they saw a robot in operation. They had never seen a robot before. After the operator had pushed some buttons the robot began to perform a sequence of operations. By the time the manipulator performed some actions, feedback devices had provided the necessary information about the robot's motions and positions.

The control system directed the manipulator's actions. After the manipulator had completed all the operations, it put all the work-pieces into storage. With the help of a gripping device, the robot operated very accurately and precisely. When the robot completed all the actions the operator switched it off. By the end of the term the students will have learned everything about robot design, i.e. the body structure, the power system, the control system and various sensors, actuators and manipulators.

2. What expressions with these words can you find in the text:

robot, tasks, operations, device, actions, information; to relieve, to perform, to provide.

3. Complete the sentences according to the text.

The students ... never ... a robot before then. After man had ... the robot, he ... his possibilities and ... himself from monotonous and ... tasks. ... the time the manipulator ... some actions, feedback devices had ... the necessary ... about the robot's motions. By the end of the…the students will… …everything about robot…, i.e. …system, actuators, …and systems.

4. Discuss the following facts with a partner.

1. Archytas of Tarentum, a pal of Plato’s, built a mechanical bird driven by a jet of steam or compressed air-arguably history’s first robot-in the fifth century B. C.

2. More than a million industrial robots are now in use, nearly half of them in Japan.

Unit 4.Types of robots by application

1. Read the text. Write the key terms related to the topic.

What is a robot? A lot of people think of robots as machines that both do the work of humans and look like them. Strictly speaking, this devices should be termed androids, from the Greek «andros» meaning “of man” and «aidos» meaning “form”.

Nowadays, robots do a lot of different tasks in many fields and the number of jobs entrusted to robots is growing steadily. That's why one of the best ways how to divide robots into types is a division by their application.

Industrial robots are robots used in an industrial manufacturing environment. Usually these are articulated arms specifically developed for such applications as welding, material handling, painting and others. This type could also include some automated guided vehicles and other robots.

Domestic or household robots are robots used at home. This type of robots includes many quite different devices such as robotic vacuum cleaners, robotic pool cleaners, sweepers, gutter cleaners and other robots that can do different chores.

Medical robots are used in medicine and medical institutions.

Service robots are different data gathering robots, robots made to show off technologies, robots used for research, etc.

Military robots are robots used in military. This type of robots includes bomb disposal robots, different transportation robots, reconnaissance drones. Often robots initially created for military purposes can be used in law enforcement, search and rescue and other related fields.

Entertainment robots are used for entertainment. This is a very broad category. It starts with toy robots such as the running alarm clock and ends with real heavyweights such as articulated robot arms used as motion simulators.

Space robots are robots used in space as a separate type. This type would include robots used on the International Space Station.

2. Rearrange the letters in the brackets to complete the following sentences.

1. (STIMECDO) type of robots includes many quite different devices such as robotic vacuum cleaners, robotic pool cleaners, sweepers, gutter cleaners and other robots that can do different chores.

2. (DOINSTRIAL) robots are used in an industrial manufacturing environment. (LIRAMITY) type of robots includes bomb disposal robots, different transportation robots, reconnaissance drones.

3. Toy robots are considered to be (ERTENTAINMENT) robots.

4. Robots made to show off technologies, robots used for research are (VERSICE) robots.

3. Complete the table below.

Type of robots	Purpose of application
… 1 …	Exploring the site and sending colour images to Earth
… 2 …	Helping during operations, assisting surgeons
Industrial robots	… 3 …
Military robots	… 4 …
… 5 …	Using as motion simulators
Domestic robots	... 6 …

4. Discuss the following questions with a partner.

1. What is a robot?
2. What types are robots divided into?
3. What is industrial type of robots?
4. What industries are the biggest users of robots?

5. Discuss with your friend the types of robots and their application.

Unit 5. Industrial robots

1. Read the text. Write the key terms related to the topic.

A typical industrial robot consists of a tool, an industrial robotic arm, a control cabinet, a control panel, a teach pendant, as well as some other peripheral equipment. So what is what?

A tool is a device designed for a specific task, for example, welding or painting. The robot arm is the thing that moves the tool. But not every industrial robot resembles an arm.

A control cabinet resembles robot's brains. A control panel and a teach pendant make up the user environment. These parts usually come together.

A control panel is intended to be used by operator to do some routine tasks. For example, changing programs or controlling the peripheral devices. Whereas the teach pendant is usually used only in time of programming, although, it can be left connected to the control cabinet if additional memory is needed to execute a program.

An industrial robot can be successfully used instead of a human worker. There are jobs that no one really wants to do. These are those repetitive, tedious jobs that require a lot of monotonous action from the side of a worker, like picking something from one conveyor to another.

If it is always the same task you could use an automated solution tailored specifically for your needs. What if it's not the case? The situation where a factory needs to be more and more flexible is becoming more and more common. In these cases a reprogrammable robot which can be used for different tasks is the right solution.

Also, you should consider a robot worker for those tasks that are hazardous for a human worker. For example, surface treatment with dangerous chemicals and work in the environment that is hazardous. In many cases like the ones mentioned it is wiser and cheaper in the long term to use a robot than to hire a worker.

And of course, there are jobs that can't be done by a human. Like lifting very heavy weights or working in conditions unsuitable for human life. Again, specific automated solutions can be applied in many of these cases. However, if flexibility is required then a robot should be considered.

2. Give Russian equivalents to the following terms:

tool, industrial robotic arm, control cabinet, control panel, teach pendant, device, automated solution.

3. Complete the sentences with the word combinations given above:

a control panel, a teach pendant, flexibility, an industrial robot, an industrial robotic arm, a teach pendant.

1. A typical industrial robot consists of a tool, … , a control cabinet, a control panel, … , as well as some other peripheral equipment.

2. A control panel and … makes up the user environment.
3. … is intended to be used by operator to do some routine tasks.
4. … can be successfully used instead of a human worker.
5. If … is required then a robot should be considered.

4. Match the following words and word combinations with their definitions.

The robot arm is	… a device designed for a specific task, for example, welding or painting
A tool is	… the thing that moves the tool
An industrial robot can	… intended to be used by operator to do some routine tasks
A control panel is	… make up the user environment.
A control panel and a teach pendant	… be successfully used instead of a human worker.

5. Work in pairs. Take turns to ask as many questions to the text as possible and answer them.

6. Complete the following sentences. Use them to make a summary of the text.

1. A typical industrial robot consists of … .
2. A tool is a device designed for … .
3. The robot arm is the thing that … .
4. A control cabinet resembles … .
5. A control panel is intended to be used by operator to do … .
6. An industrial robot can be successfully used … .
7. In many cases it is wiser and cheaper in the long term to use a robot … .

Unit 6. How industrial robots work

1. Read the text attentively to learn how the most common manufacturing robot works.

When engineers devised a steam engine in the 18th century, some people said that they had already invented everything possible. However, our mankind has produced a great number of other inventions since that time. Robots are one of them.

Nowadays people use 90 % of robots for heavy, repetitive manufacturing work. These robots handle tasks that are difficult, dangerous or boring to human beings.

The most common manufacturing robot is the robotic arm. It typically consists of seven metal segments. Tiny motors or actuators put them into operation when a special computer gives them certain instructions.

An industrial robotic arm with six joints closely resembles a human arm – it has the equivalent of a shoulder, an elbow and a wrist. This type of robot has six degrees of freedom, i. e. it can turn in six different ways. A human arm, by comparison, has seven degrees of freedom. Your arm moves your hand from place to place. Similarly, the robotic arm moves an end effector from place to place. You can supply robotic arms with all sorts of end effectors, which will perform a certain task, for example it will grasp and carry different objects. Robotic hands often have built-in pressure sensors that tell the computer how hard the robot is gripping a particular object. That's why the robot doesn't drop or break whatever it's carrying. Robots do their work more efficiently than human beings because they are so precise. They always drill in the exactly the same place, and they always tighten bolts with the same amount of force, no matter how many hours they've been in operation.

2. Say whether these statements are true or false. Correct the false ones.

1. When engineers created a robot some people said that they had already created everything possible.
2. Engineers build 90 % of robots for entertainment nowadays.
3. The most widely- spread manufacturing robot is the robotic arm.
4. You can supply the robotic arm with various actuators.
5. A special programme in the computer tells the robot not to drop the object it is carrying.
6. Robots are more efficient in their work than human beings because they are smarter.

3. Expand these sentences with the facts from the text.

1. People use robots in industry for various reasons.
2. The robotic arm resembles a human arm.
3. The end-effectors in the robotic arm perform different tasks.
4. Robotic hands often have built-in pressure sensors.
5. Robots are very precise in their work.

4. Complete the following sentences. Use them to make a summary of the text.

1. Nowadays people use 90% of robots for heavy … .
2. Tiny motors or actuators put them into operation when a special computer gives … .
3. Your arm moves your hand from place to place. Similarly, the robotic arm … .
4. You can supply robotic arms with all sorts of end effectors, which will perform a certain task, for example … .
5. They always drill in the exactly the same place, and they always tighten bolts with the same amount of force … .

Unit 7. Basic components of robots

1. Read the text. Write the key terms related to the topic.

The structure of a robot is usually mostly mechanical and is called a kinematic chain. It is functionally similar to the skeleton of human body.

The controller is the brain of the industrial robotic arm and allows the parts of the robot to operate together. It works as a computer and allows the robot to also be connected to other systems. The robotic arm controller runs a set of instructions written in code called a program. The controller is the processing interface between the robot and its environment. It provides intelligence and feedback to the robot through the compilation of the sensor measurements. It also acts as a storage device, retaining the sensory information and inputted programs.

The computation engine is generally able to process many tasks at one time and seamlessly changes calculations to account for sensory information. The controller includes the hardware that interfaces with the outside world. It stores the user interface, which is used to input various commands.

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

Sensors are what allow a robot to gather information about its environment. This information can be used to guide the robot's behavior. Some sensors are relatively familiar pieces of equipment. Other types of sensors are more complex, and give a robot more interesting capabilities. Robots equipped with Light Detection and Ranging (LIDAR) sensors use lasers to construct three dimensional maps of their surroundings as they navigate through the world. Supersonic sensors are a cheaper way to accomplish a similar goal only using high frequency sound instead of lasers.

Sensors allow the robotic arm to receive feedback about its environment. One use of these sensors is to keep two robots that work closely together from bumping into each other. Vision sensors allow a pick and place robot to differentiate between items to choose and items to ignore.

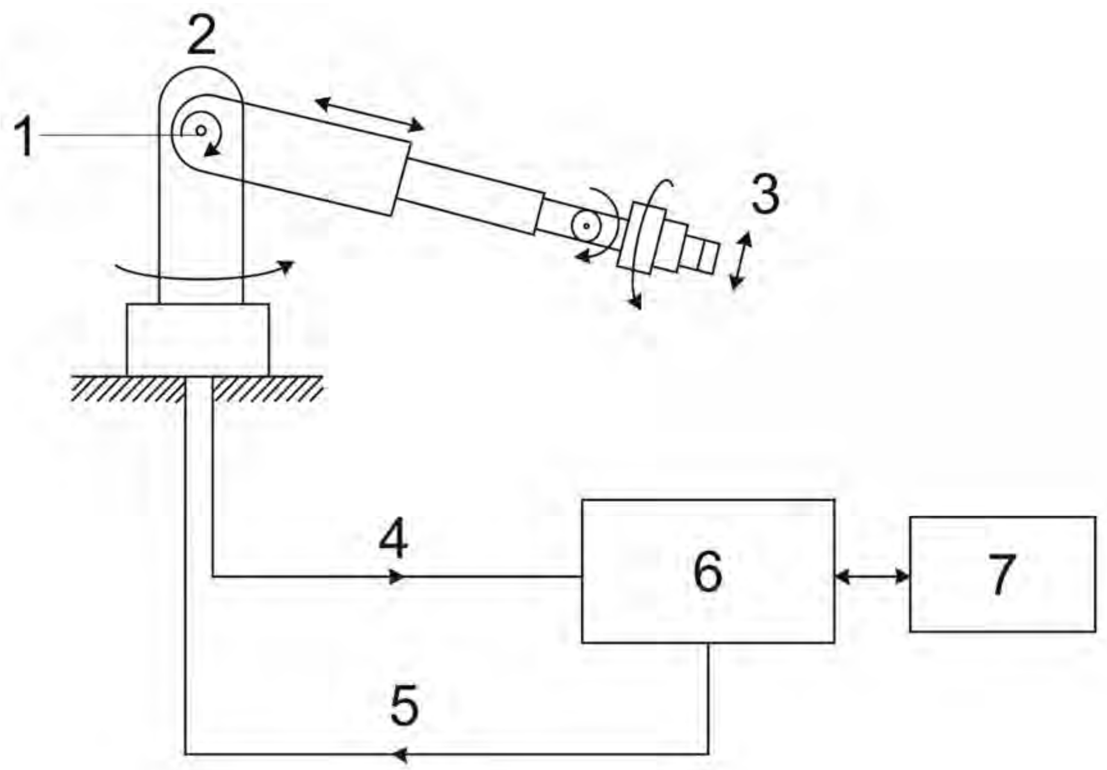
Cameras allow a robot to construct a visual representation of its environment. This allows the robot to judge attributes of the environment that can only be determined by vision, such as shape and color, as well as aid in determining other important qualities, such as the size and distance of objects.

Microphones allow robots to detect sounds. Some robots come equipped with thermometers and barometers to sense temperature and pressure.

2. Try to guess meanings of the following word combinations. Use the dictionary in case you need it.

kinematic chain, controller, robotic arm controller, end effector, feedback, joint, joint sensor data, joint drive signal, interface, storage device, actuator, supersonic sensors, to spin a wheel, teach pendant, manipulator.

3. Use the words from task 2 and give your definitions of the components.



4. Work in pairs and decide if these sentences are true or false.

1. The controller is the brain of the industrial robotic arm and allows the parts of the robot to operate together.
2. The robotic arm controller doesn't run a set of instructions written in code called a program.
3. The controller includes the computation engine that interfaces with the outside world.
4. Actuators are like the muscles of a robot, the parts which convert kinetic energy into movement.
5. Sensors allow the controller to receive feedback about its environment.
6. With the help of cameras robots detect sounds.

5. Complete the sentences with the word combinations given above:

a computer, human body, electric motors, a visual representation, lasers, the processing interface, sensory information.

1. The structure of a robot is similar to the skeleton of … .
2. The controller works as … and allows the robot to also be connected to other systems.
3. The controller is … between the robot and its environment.
4. The computation engine is generally able to process many tasks at one time and seamlessly changes calculations to account for … .
5. By far the most popular actuators are … that spin a wheel or gear.

6. Robots equipped with Light Detection and Ranging (LIDAR) sensors use … to construct three dimensional maps of their surroundings.

7. Cameras allow a robot to construct … of its environment.

6. Make a short summary of the text.

Unit 8. The mechanical structure of a robot

1. Read the text. Write the key terms related to the topic.

Depending on the type of robot and the application, the mechanical structure of a robot can be divided into two parts, the main manipulator and a wrist assembly. The manipulator will position the end effector while the wrist will control its orientation.

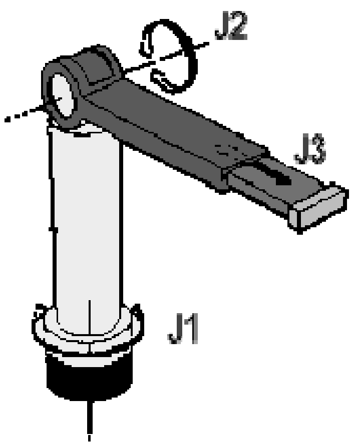
The work envelope is the space that can be reached by the end of the robot arm. All interaction between the robot, and other machines, parts and processes must take place within the work envelope.

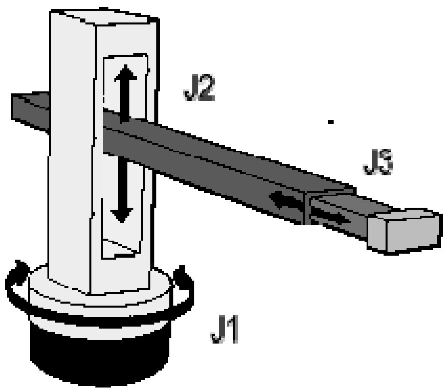
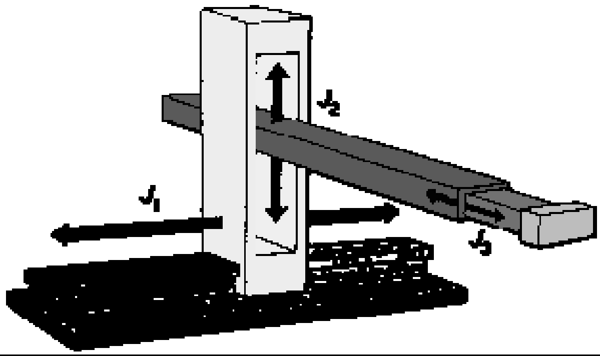
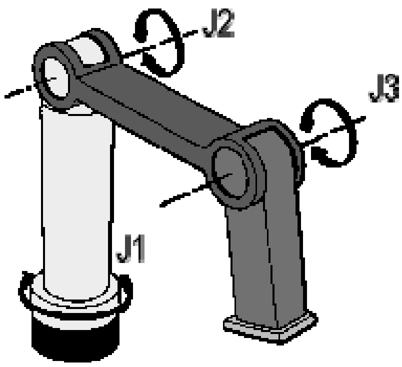
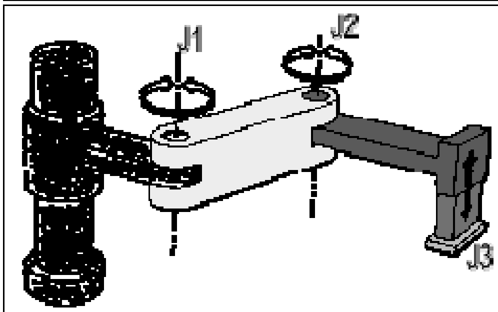
The structure of the robot consists of a number of links and joints, a joint will allow relative motion between two links. Two types of joints are used, a revolute joint to produce rotation and a linear prismatic joint. To achieve complete control of the end effectors position and orientation a minimum of six joints are required. The basic robot arm has three joints, this allows the tool at the end of the arm to be positioned any where in the robots working envelope. Even though there are a large number of robot configurations that are possible, only five configurations are commonly used in industrial robotics.

2. Give Russian equivalents to the following terms:

main manipulator, wrist assembly, end effector, work envelope, links and joints, revolute joint, linear prismatic joint.

3. Using the table below discuss with your friend robot configurations.

Polar		The linear extending arm is capable of being rotated around the horizontal and vertical axes.

Cylindrical		The linear extending arm can be moved vertically up and down around a rotating column
Cartesian and Gantry:		Three orthogonal sliding or prismatic joints
Jointed Arm		Three joints arranged in an anthropomorphic configuration
Selective Compliance Assembly Robotic Arm, SCARA		Two rotary axes and a linear joint

4. Rearrange the letters and make your own sentences with the words.

TEFURU, GNLYTCOHOE, ENEENLIICTLG, OSESSNR, CINHEMA, MROGARP, MDNOIAUH, INGNETORCOI, ETCPRMUO, IAIARIFTCL

Unit 9. Rescue Robots

1. Read and translate the text into Russian.

A rescue robot is a robot that has been designed for the purpose of rescuing people Common situations that employ rescue robots are mining accidents, urban disasters, hostage situations, and explosions. Rescue robots were used in the search for victims and survivors after the September 11 attacks in New York. The benefits of rescue robots to these operations include reduced personnel requirements, reduced fatigue, and access to otherwise unreachable areas.

During September 11 disasters rescue robots were first really tested. They were sent into the rubble to look for survivors and bodies. The robots had trouble working in the rubble of the World Trade Center and were constantly getting stuck or broken. Since then many new ideas have been formed about rescue robots. Engineers and scientists are trying to change the shapes of the robots and take them from wheels to no wheels. “Strong government funding and support is needed if search and rescued robots are to see widespread use in fewer than 14 years. This means that without the help of government the technology for these devices are not available or they cost too much. These robots are very important in disaster scenarios and are hopefully taking a change for the better.

People like Daniel Goldman, a biophysicist at Georgia Tech, has started building a robot that Piore says “is less like an ATV and more like a sandfish lizard”. Goldman has been spending a lot of time researching and studying the movements of sandfish lizards and trying to develop that into his own robotic idea. Piore states that his robot will be able to “burrow deeper or snake its way back to the surface” just like a sandfish lizard. This will be helpful in many disaster scenarios. Goldman is trying to develop this robot to be able to maneuver though such terrain as rubble, like in the World Trade Center disaster.

Rescue robots in development are being made with abilities such as searching, reconnaissance and mapping, removing or shoring up rubble, delivery of supplies, medical treatment, and evacuation of casualties. Even with all these ideas coming about there are still some technical challenges that remain. Robin Murphy, a professor of computer science and engineering, says that “Real disasters are infrequent, and every one is different. The robots never get used exactly the way you think they will, and they keep uncovering new bottlenecks and problems. So it’s an emerging technology”.

Murphy states that most rescue robots are not tested in real life situations and more in a situation that the robot can handle. The possible solutions to these problems are what an associate professor of robotics- Howie Choset, is working on. Choset is working on building a “snake robot”. These snake robots are “thin, legless devices with multiple joints”. These snake robots will be used to go places where normal wheeled robots cannot go. The technology still needs some work and the trials they are going through with them aren’t going perfect. Most tests and studies are helping Choset out and are improving these snake robots. “More animal studies would help” says Choset. The robot is based on snakes and their movements, but considering that snakes are made up of 200 bones and the robot is made up of 15 links, there are problems in functionality.

There are three main levels of challenges. First, the information processing of the robot. Second, the mobility of the robot. Third, the manipulation of the robot. Bringing these robots into real-world use and being able to utilize them in all situations is so close to becoming a reality. “We're just inches away” Murphy says, “a lot of software is just waiting for the hardware to catch up”.

Fifteen scientists from all over the world were put together on a team of search and rescue professionals from the Federal Emergency Management Agency’s Indiana. They were put together to find problems with rescue robots. Together they put together the R4 program. Which is Rescue Robots for Research and Response. This is a three-year grant and it is there to improve the rescue robot technology and human performance. Three robots were tested during this time and a fourth was introduced to the scientists. Each robot spent about an hour moving around in the rubble and was observed for their movement and how well they were able to make their way through the rubble. They tested the robots on the rubble from the World Trade Center disaster so they could better prepare for a similar disaster. They were looking for two things with these rescue robots. First, how to detect victims and unsafe conditions for rescuers in a highly cluttered, unfavorable environment. Second, how to ensure sensor coverage of a particular volume of space. In one series of tests, robots were put into dark, mine-like conditions.

However, the robots were unable to locate half of their targets. Some changes will need to be made if they ever expect these robots to function properly. But once they figure out what they need they will hopefully serve a great purpose and be a greater asset to rescuers.

2. Work in pairs and decide if these sentences are true or false. Correct the false ones.

1. The benefits of rescue robots to these operations include reduced personnel requirements, reduced fatigue, and access to otherwise unreachable areas.
2. Goldman is trying to develop this robot to be able to maneuver though such terrain as rubble, like in the World Trade Center disaster.
3. Murphy states that most rescue robots are tested in real life situations and more in a situation that the robot can handle
4. In one series of tests, robots were put into dark, mine-like conditions. However, the robots were unable to locate half
5. Engineers and biologists are trying to change the shapes of the robots and take them from wheels to no wheels.

3. Try to guess the meanings of the following word combinations. Use the dictionary in case you need it:

mining accidents ,hostage situations, reduced fatigue, unreachable areas. delivery of supplies, emerging technology evacuation of casualties, unfavorable environment.

4.Discuss the following facts with a partner.

1. There are two robots on Mars - Spirit and Opportunity. They were built to last 90 days on Mars but they lasted for several years. Curiosity is the latest rover to land on Mars to explore the planet.
2. A robot has been created that uses bacteria-filled fuel cells. The robot is capable of producing electricity from dead flies to power its battery. It can also use rotten apples to create fuel.

Robot Glossary of Terms

Accuracy – A measure of a robot's capability to repeat the same task multiple times without changing the closeness to a certain point.

Actuator – A piece of equipment that allows a robot to move by conversion of different energy types such as electrical or mechanical processes using liquid or air.

Algorithm – A list of steps used to find a solution to a given problem.

Analytical Methods – A mathematical way to solve problems without repetitive attempts to approximate an answer.

Application Program – A sequence of steps that specifies what jobs the robots will perform. The program can be personalized by the owner to fit specific designs.

Assembly Robots – A mechanical device that uses automation to add interchangeable parts to a product in a sequential manner to create a finished product.

Automatic Mode – The state when the robot begins self-moving operations.

Axis – The point that something such as a tool rotates around. The number of axes a robot has varies, but the majority of industrial robots are 4-axis or 6-axis.

Axis acceleration – The maximum acceleration that a particular axis can attain while the robot is loaded with the suggested payload.

Cam – The centerline of rotation of this part is not at the geometric center making other parts pushing on it to move in and out.

Cartesian Robot – The axes of the three Prismatic or linear motion joints of the robot are in the same direction of a Cartesian coordinator.

Collision Sensor – A sensor that detects and informs the controller to stop the robot prior to or during a crash.

Compensator – A remote device that involves multiple shear pads to help peg-in-hole operations. The shear pads are elastomers, also known as polymers and the device uses three to twelve of these shear pads.

Control Device – An instrument that allows a person to have control over a robot or automated system for times such as startup or an emergency.

Control Program – The control information built into the robot or automated system that allows for possible behaviors. The control information is not expected to be altered.

Coordinated Straight Line Motion – The Tool Center Point follows a specific path allowing the axes of the robot to come to their specified end points at the same time. This allows for a smooth operation of movement.

Cylindrical Robot – The axes of the robot correspond to a cylindrical coordinate system.

Degrees of Freedom – The amount of values in a system possible of variation. A robotic joint is equal to one degree of freedom.

Dexterity – The measure of the robot's skill of completing specific difficult paths.

Drive Power – Actuators convert this source of energy into usable energy for the robot's movement.

Dynamic Model – This model shows the forces causing the robot's movement.

Enabling Device – The user activates the device allowing for the robot and machinery to move. When deactivated motion is stopped preventing harmful situations.

End-effector – The application tools located at the end of the robot's arm and are typically connected to robot flanges.

Feedback – A signal from the robot equipment about conditions as they actually exist, rather than as the computer has directed them to exist.

Flexibility – The diverse jobs that a robot is capable of executing.

Fully Constrained Robot – The number of equality constraints on the robot are equal to the number of independent joints.

Hybrid – The robot has a combination of pick and place and servo controlled parts.

Industrial Robot – A manipulator that is designed to perform various programmed tasks during manufacturing. Industrial robots are automated by a program that controls its duties that tend to be dangerous or difficult for humans.

Industrial Robot System – A system of robots, machinery, and devices that are programmed to perform operations while incorporating an interface.

Industrial Robotics – The idea of incorporation of a robot system for production.

Interface – The separation between robots and the equipment not nearby. The sensors that are required for communication between the devices use signals relaying input and output data.

Interlock – The control of a device starting or stopping is dependent upon the action of another device.

Internal Sensor – An apparatus within the manipulator arm that sends information on motion to a control unit.

Joint space – The area and coordinate system the joints of the robot consume.

Jointed Arm Robot – The arm of the robot has two junctions allowing for rotation and enhanced movement much like a person's shoulder and elbow on their arm.

Limiting Device – A separate apparatus that places a restriction on the maximum envelope. This restriction occurs by terminating motion of the robot.

Linearly Dependent – Numbers or functions related by addition, subtraction or multiplying by a scalar.

Maintenance – Ensuring that robots and manufacturing systems are working properly and repairing any problems observed.

Manipulator – Allows for movement of a part through multiple joints on the mechanical device also known as the arm of the robot.

Motion axis – The line defining the axis of motion either linear or rotary, of a segment of a manipulator.

Muting – Turning off the presence-sensing safeguarding device during a part of robot operation.

Off-Line Programming – A way to store procedure information for a robot on a computer to be used in the future.

On-Line Programming – The computer program controls the robot as the information and procedures are inputted into the computer.

Operating Envelope Space – The part of the restricted envelope taken up during the specified robots movements.

Operator – This person begins and ends processes the robot performs while observing to ensure proper procedures are occurring.

Parallel Robot – The linear or rotation joints of the robot's arms match each other in position and direction.

Pick and Place Robot – A type of robot that moves parts from one place to another.

Plant Description – Information on the motion and forces of the robot.

Point-To-Point Motion – The user specifies points for the robot to follow along the path. The movement is point to point as opposed to a continuous motion.

Programmable Logic Controller – (PLC) A device that allows for control of the equipment used for production. The user has more control with this device since it can provide the status of performance of the robots.

Reach – The distance from the center of the robot to the fullest extension of the robotic arm.

Reliability – A measure of the robot's end-effector's ability to perform similar operations multiple times based on similar operating conditions.

Remanufacture – To improve and advance robots in order to meet current standards.

Repeatability – The variability of the end-effector's position and orientation as the robot makes the same moves under the same conditions (load, temp, etc.)

Restricted Envelope Space – A part of the maximum envelope in which the distance determines the boundaries the robot moves after the limiting device is activated.

Robot – A piece of equipment with the capability to be programmed to perform quick and accurate operations multiple times.

Robot simulation – To imitate and observe processes through a model of the system.

Robot System Integrator – A business that merges robots, peripherals, and manufacturing machinery into a production system that functions as a single unit to perform manufacturing tasks.

Robotic Self-Motion – The robot maintains the position of the end-effector while allowing other parts on the robot to move.

SCARA Robot – A type of robot consisting of two concurrent joints that rotate and meet certain needs within the same plane.

Sensor – A device that transmits the resulting signal or data for providing a measurement, operating a control, or both.

Serial robot – A type of robot that consists of one series of joints united with links.

Shoulder – The joint of the robot's manipulator arm connected to the base.

Simulation – Modeling a situation through mathematics or computer programming.

Single Point of Control – Operations of the robot are controlled solely by one source.

Singularity – A point in the robot's movement where the joints become redundant.

Slow Speed Control – The robot's velocity of movement is decreased enough that the user can remove material or stop motion completely.

Spherical Robot – Consisting of three joints allowing for movement among a polar coordinate system.

Swing – A robot's rotational movement with respect to its centerline.

Teach – The generation and storage of a series of positional data points affected by moving the robot arm through a path of intended motions.

Velocity-level – The measure of variation of joint position over time. Single integration yields

Work Envelope– The boundary of space a robot can perform operations.

Workspace – The area the robot can reach to perform operations. A portion of the maximum reach space.

Wrist – The end-effector is connected to this joint on the manipulator arm.

Yaw – The side-to-side motion of the end-effector's rotation at an axis.

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