**Методическая разработка по теме “Automated Industrial Systems”**

Разработчик: Ольга Викторовна Шапкайц

Обучающиеся: студенты 3 курса

Специальность: Автоматические системы управления

**Automated industrial systems (Part 1)**

Automation is the system of manufacture perform­ing certain tasks, previously done by people, by machines only. The sequences of operations are controlled auto­matically. The most familiar example of a highly auto­mated system is an assembly plant for automobiles or other complex products.

The term automation is also used to describe nonmanufacturing systems in which automatic devices can op­erate independently of human control. Such devices as automatic pilots, automatic telephone equipment and automated control systems are used to perform various operations much faster and better than could be done by people.

Automated manufacturing had several steps in its development. Mechanization was the first step necessary in the development of automation. The simplification of work made it possible to design and build machines that resembled the motions of the worker. These specialized machines were motorized and they had better production efficiency.

Industrial robots, originally designed only to perform simple tasks in environments dangerous to human work­ers, are now widely used to transfer, manipulate, and position both light and heavy workpieces performing all the functions of a transfer machine.

In the 1920s the automobile industry for the first time used an integrated system of production. This method of production was adopted by most car manufacturers and became known as Detroit automation.

The feedback principle is used in all automatic-con­trol mechanisms when machines have ability to correct themselves. The feedback principle has been used for centuries. An outstanding early example is the flyball governor, invented in 1788 by James Watt to control the speed of the steam engine. The common household ther­mostat is another example of a feedback device.

Using feedback devices, machines can start, stop, speed up, slow down, count, inspect, test, compare, and measure. These operations are commonly applied to a wide variety of production operations.

Computers have greatly facilitated the use of feedback in manufacturing processes. Computers gave rise to the development of numerically controlled machines. The motions of these machines are controlled by punched paper or magnetic tapes. In numerically controlled ma­chining centres machine tools can perform several dif­ferent machining operations.

More recently, the introduction of microprocessors and computers have made possible the development of computer-aided design and computer-aided manufacture (CAD and CAM) technologies. When using these systems a designer draws a part and indicates its dimensions with the help of a mouse, light pen, or other input device. Af­ter the drawing has been completed the computer automatically gives the instructions that direct a machining centre to machine the part.

Another development using automation are the flex­ible manufacturing systems (FMS). A computer in FMS can be used to monitor and control the operation of the whole factory.

Automation has also had an influence on the areas of the economy other than manufacturing. Small comput­ers are used in systems called word processors, which are rapidly becoming a standard part of the modern office. They are used to edit texts, to type letters and so on

Many industries are highly automated or use automa­tion technology in some part of their operation. In com­munications and especially in the telephone industry di­alling and transmission are all done automatically. Rail­ways are also controlled by automatic signalling devices, which have sensors that detect carriages passing a par­ticular point. In this way the movement and location of trains can be monitored.

Not all industries require the same degree of automa­tion. Sales, agriculture, and some service industries are difficult to automate, though agriculture industry may become more mechanized, especially in the processing and packaging of foods.

The automation technology in manufacturing and as­sembly is widely used in car and other consumer product industries.

Nevertheless, each industry has its own concept of automation that answers its particular production needs.

**Vocabulary**

automation – автоматизация

manufacture – производство

previously – ранее

sequences of operations – последовательность действий

assembly plant – сборочный завод

nonmanufacturing – не относящийся к обрабатывающей промышленности

automated control systems – автоматизированная система управления

to resemble – походить, иметь сходство

workpieces – детали

transfer machine – 1) многопозиционный (станок)автомат; 2) (автоматическая) станочная линия; 3) (автоматическая) сборочная линия

integrated system – 1) встроенная система; 2) комплексная система; интегрированная система; 3) (микро)система в интегральном исполнении;

feedback – обратная связь

device – устройство, приспособление; механизм; аппарат, машина, прибор

to apply – применять к (чему-л.); использовать для (чего-л.)

facilitate – облегчать; содействовать; способствовать; помогать, продвигать

punched paper tape – перфорированная бумажная лента, бумажная перфолента

computer-aided design (CAD) – автоматизированное проектирование

computer-aided manufacturing (CAM) – 1) автоматизированное производство; 2) автоматизация производственных процессов; 3) автоматизированная подготовка производства

dimension – измерение, размеры

flyball governor – центробежный регулятор

lexible manufacturing systems (FMS) – гибкие производственные системы

to detect – замечать, открывать, обнаруживать

to require – нуждаться (в чём-л.); требовать (чего-л.)

*II.* *Answer the questions to the text.*

1. How is the term automation defined in the text?
2. What is the most “familiar example” of automation given in the text?
3. What was the first step in the development of automaton?
4. What were the first robots originally designed for?
5. What was the first industry to adopt the new integrated system of production?
6. What is feedback principle?
7. What do the abbreviations CAM and CAD stand for?
8. What is FMS?
9. What industries use automation technologies?

*III. Translate the following sentences into Russian.*

1. The term automation is also used to describe nonmanufacturing systems.
2. The feedback principle is used in all automatic-con­trol mechanisms.
3. Computers gave rise to the development of numerically controlled machines.
4. Using feedback devices, machines can start, stop, speed up, slow down, count, inspect, test, compare, and measure.
5. More recently, the introduction of microprocessors and computers have made possible the development of CAD and CAM technologies.
6. Another development using automation is the flex­ible manufacturing systems.
7. Small comput­ers are used in systems called word processors.
8. Not all industries require the same degree of automa­tion.
9. Each industry has its own concept of automation.
10. The sequences of operations are controlled auto­matically.

*IV. Put the words from the box into sentences.*

**the feedback principle, word processors, automation, manufacturing, mechanization, consumer, signaling, computers, microprocessors, operations**

1. The sequences of … are controlled auto­matically.
2. The term … is also used to describe nonmanufacturing systems in which automatic devices can op­erate independently of human control.
3. … was the first step necessary in the development of automation.
4. … is used in all automatic-con­trol mechanisms when machines have ability to correct themselves.
5. … have greatly facilitated the use of feedback in manufacturing processes.
6. More recently, the introduction of … and computers have made possible the development of CAD and CAM technologies.
7. Another development using automation are the flex­ible … systems.
8. Small comput­ers are used in systems called …, which are rapidly becoming a standard part of the modern office.
9. Rail­ways are also controlled by automatic … devices.
10. The automation technology in manufacturing and as­sembly is widely used in car and other … product industries.

*V. Say whether these sentences are* ***True or False***.

1. Automation is the system of manufacture perform­ing certain tasks.
2. In the 1940s the automobile industry for the first time used an integrated system of production.
3. The feedback principle is used in not all automatic-con­trol mechanisms.
4. All industries require the same degree of automa­tion.
5. Many industries are highly automated or use automa­tion technology in some part of their operation.
6. Rail­ways are also controlled by automatic signaling devices.
7. The introduction of microprocessors has made possible the development of computer-aided design and computer-aided manufacture (CAD and CAM).
8. A computer in FMS can be used to monitor and control the operation of the whole factory.
9. Using feedback devices machines can start and stop.
10. Computers have greatly facilitated the use of feedback in manufacturing processes.

*VI. Translate the following sentences into English.*

1. Роботы первоначально разработаны для выполнения простых задач в местах опасных для человека.
2. В 1920-ых автомобильная промышленность впервые использовала интегрированную систему производства.
3. Принцип обратной связи использовался в течение многих столетий.
4. Компьютеры сильно облегчили использование обратной связи в производственных процессах.
5. Железные дороги управляются автоматическими сигнальными устройствами.
6. Механизация была первым шагом, необходимым в развитии автоматизации.
7. Автоматизированные системы управления используются, чтобы выполнять различные операции намного быстрее и лучше, чем человек.
8. Автоматизация широко используется в обработке и упаковке продуктов.
9. У каждой промышленности есть своя собственная концепция автоматизации.
10. Много отраслей промышленности чрезвычайно автоматизированы.

*VII. Read and translate the text paying attention to the words given.*

**Automation (part 2)**

Automation is the use of control systems (such as numerical control, programmable logic control, and other industrial control systems), in concert with other applications of information technology (such as computer-aided technologies [CAD, CAM, CAx]), to control industrial machinery and processes, reducing the need for human intervention. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provided human operators with machinery to assist them with the muscular requirements of work, automation greatly reduces the need for human sensory and mental requirements as well. Processes and systems can also be automated.

Automation plays an increasingly important role in the global economy and in daily experience. Engineers strive to combine automated devices with mathematical and organizational tools to create complex systems for a rapidly expanding range of applications and human activities.

Many roles for humans in industrial processes presently lie beyond the scope of automation. Human-level pattern recognition, language recognition, and language production ability are well beyond the capabilities of modern mechanical and computer systems. Tasks requiring subjective assessment or synthesis of complex sensory data, such as scents and sounds, as well as high-level tasks such as strategic planning, currently require human expertise. In many cases, the use of humans is more cost-effective than mechanical approaches even where automation of industrial tasks is possible.

Specialised hardened computers, referred to as programmable logic controllers (PLCs), are frequently used to synchronize the flow of inputs from (physical) sensors and events with the flow of outputs to actuators and events. This leads to precisely controlled actions that permit a tight control of almost any industrial process.

Human-machine interfaces (HMI) or computer human interfaces (CHI), formerly known as man-machine interfaces, are usually employed to communicate with PLCs and other computers, such as entering and monitoring temperatures or pressures for further automated control or emergency response. Service personnel who monitor and control these interfaces are often referred to as stationary engineers.

**Vocabulary**

numeric(al) control – числовое программное управление

programmable logic control – 1) программируемая логика электроавтоматики; 2) программируемый командоаппарат, программируемый контроллер, ПК

to reduce – ослаблять, понижать, сокращать, уменьшать

strive – стараться, пытаться; стремиться, прилагать усилия

to be beyond the scope – выходить за пределы чего-л.

capability – способность

cost-effective – доходный, прибыльный, рентабельный

actuator – 1) исполнительный механизм; 2) рабочий орган; 3) (силовой) привод; пускатель

human-machine interface (HMI) – человеко-машинный интерфейс

computer human interfaces (CHI) = man-machine interface – интерфейс "человек - машина"

*VIII. Insert the missing information into the sentences.*

1. Automation plays an increasingly important role in the global … and in daily experience.
2. Engineers … automated devices with mathematical and organizational tools to create complex systems for a rapidly expanding range of applications and … .
3. In many cases, the use of humans is more … than mechanical approaches even where automation of industrial tasks is possible.
4. This leads to precisely controlled actions that permit a … of almost any industrial process.
5. Human-machine interfaces (HMI) or computer human interfaces (CHI) are usually employed to … with PLCs and other computers.
6. Automation is the use of … to control industrial machinery and processes, reducing the need for human intervention.
7. In the scope of industrialization, automation is a … .
8. Processes and systems can also be … .
9. Many roles for humans in industrial processes presently lie beyond ….
10. Tasks requiring subjective … of complex sensory data, such as scents and sounds, as well as high-level tasks such as strategic planning, currently require human expertise.

*IX. Find the Russian equivalents to the English ones:*

|  |  |
| --- | --- |
| **Automated Guided Vehicle** | изменяемость обратимость |
| **fieldbus** | рабочая сила; трудовые ресурсы |
| **increasing productivity** | автоматизированное проектирование |
| **workforce** | автоматизированная технология |
| **IT** | система автоматизированного проектирования, САПР |
| **human interface** | человеко-машинный интерфейс |
| **programmable logic control** | малая автоматическая телефонная станция, малая АТС |
| **Human-machine interface** | промышленная шина (обеспечивающая взаимодействие управляющего оборудования и периферийных устройств АСУТП) |
| **computer-aided technology** | увеличивающаяся производительность |
| **convertibility** | автоматическая самоходная тележка |
| **computer-aided design** | участие оператора; вмешательство оператора |
| **computer-aided management** | промышленная технология; информационные технологии |
| **community automatic exchange** | программируемое логическое устройство управления |
| **human intervention** | интерфейс с пользователем |
| **cost-effective** | рентабельный |
| **programmable logic controllers** | программируемая логика электроавтоматики |
|  | компьютеризованное управление; автоматизированное управление |

*X. Translate the following sentences into Russian and make up different kinds of questions to them. Ask your partner about automation (work in pairs or groups).*

**I group (Yes/No-questions)**

Is automation a step beyond mechanization?

**II group (Wh-questions)**

What is automation?

**III group (Tag-questions)**

Automation is a step beyond mechanization, isn’t it?

1. Automation is the use of control systems, in concert with other applications of information technology to control industrial machinery and processes, reducing the need for human intervention.
2. Mechanization provided human operators with machinery to assist them with the muscular requirements of work.
3. Automation greatly reduces the need for human sensory and mental requirements as well.
4. Engineers strive to combine automated devices with mathematical and organizational tools to create complex systems for a rapidly expanding range of applications and human activities.
5. Many roles for humans in industrial processes presently lie beyond the scope of automation.
6. Tasks requiring subjective assessment or synthesis of complex sensory data currently require human expertise.
7. Specialised hardened computers are frequently used to synchronize the flow of inputs from (physical) sensors and events with the flow of outputs to actuators and events.
8. Human-level pattern recognition, language recognition, and language production ability are well beyond the capabilities of modern mechanical and computer systems.
9. Service personnel who monitor and control the interfaces are often referred to as stationary engineers.

*XI. Translate the following sentences into English:*

1. Машинные интерфейсы обычно используются для связи с компьютерами при помощи внедрения и слежения за температурами и давлениями для дальнейшего автоматизированного контроля.
2. Автоматизация играет важную роль в глобальной экономике.
3. Процессы и системы могут быть автоматизированы.
4. Автоматизация сейчас может заменить людей в промышленных процессах.
5. Использование людей более дорогостояще, чем использование механического подхода.
6. Инженеры стараются комбинировать автоматизированные устройства с математическими и организационными оборудованиями.
7. Задачи, требующие субъективную оценку или синтез комплексных сенсорных данных, такие как запахи и звуки, а также задачи высокого уровня, такие как стратегическое планирование требуют человеческого опыта.
8. Автоматизация – это использование контрольных систем в согласованности с другими информационными технологиями.
9. Автоматизация великолепно сокращает необходимость в человеческой чувствительности и умственной потребности.
10. Узнавание образа человека, распознавание языка и способность производить язык находятся за пределами возможностей современных механических и компьютерных систем.

*XII. Determine what are advantages and disadvantages of automation. Give reasons for or against.*

1. Replacing human operators in tasks that involve hard physical or monotonous work.
2. Replacing humans in tasks that should be done in dangerous environments (i.e. fire, space, volcanoes, nuclear facilities, underwater, etc)
3. Technology limits. Current technology is unable to automate all the desired tasks.
4. Making tasks that are beyond the human capabilities such as handling too heavy loads, too large objects, too hot or too cold substances or the requirement to make things too fast or too slow.
5. Unpredictable development costs. The research and development cost of automating a process is difficult to predict accurately beforehand. Since this cost can have a large impact on profitability, it's possible to finish automating a process only to discover that there's no economic advantage in doing so.
6. Initial costs are relatively high. The automation of a new product required a huge initial investment in comparison with the unit cost of the product, although the cost of automation is spread in many product batches. The automation of a plant required a great initial investment too, although this cost is spread in the products to be produced.
7. Economy improvement. Sometimes and some kinds of automation implies improves in economy of enterprises, society or most of humankind. For example, when an enterprise that has invested in automation technology recovers its investment; when a state or country increases its income due to automation like Germany or Japan in the 20th Century or when the humankind can use the internet which in turn use satellites and other automated engines.

*XIII. a) Skim the text. What is the message of the text?*

Unemployment. It is commonly thought that automation implies unemployment because the work of a human being is replaced in part or completely by a machine. Nevertheless, the unemployment is caused by the economical politics of the administration like dismissing the workers instead of changing their tasks. Since the general economical policies of most of the industrial plants are to dismiss people, nowadays automation implies unemployment. In different scenarios without workers, automation implies more free time instead of unemployment like the case with the automatic washing machine at home. Automation does not imply unemployment when it makes tasks unimaginable without automation such as exploring mars with the Sojourner or when the economy is fully adapted to an automated technology as with the Telephone switchboard.

Environment. The costs of automation to the environment are different depending on the technology, product or engine automated. There are automated engines that consume more energy resources from the Earth in comparison with previous engines and those that do the opposite too.

*b) Scan the text for the details. Answer the following questions.*

1. What is the unemployment is caused by?

2. In what cases does automation imply unemployment?

3. What is the influence of automation on the environment?