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Identification of Individual Objects at the Intelligent Assembly Cell

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***Abstract*—**In this contribution is presented a complex design of individual objects identification in the workplace of intelligent assembly cell. Intelligent assembly cell is situated at Institute of Manufacturing Systems and Applied Mechanics and is used for pneumatic actuator assembly. Pneumatic actuator components are pneumatic roller, cover, piston and spring. Two identification objects alternatives for assembly are designed in the workplace of industrial robot. In the contribution is evaluated and selected suitable alternative for identification – 2D codes reader. The complex design of individual object identification is going out of intelligent manufacturing systems knowledge.

Intelligent assembly and manufacturing systems as systems of new generation are gradually loaded in to the mechanical production, when they are removeing human operation out of production process and they also short production times.

***Keywords*—**system, cell, intelligent, mechanics, device

I. Introduction

CURRENT production is characterized of individual customer requirements. Industrial company must to adapt of these trends, if want to generate profit. Flexible manufacturing system satisfy a given trends in these latter days, which went realized through automatization and computer techniques. Flexibility is realized through link with handling and transport technics without fixed link couplings. Industrial production develops and except using computer techniques, classic automation equipment, flexible manufacturing systems is today possible to say about implementation of new generation manufacturing systems, about intelligent manufacturing systems. All subsystems of intelligent manufacturing systems comprise of machine intelligence means [1]. Main objectives and requirements to design and create of intelligent manufacturing systems:

- streamlining of manufacturing process,
- reduction of production and intervening times,
- reduce production costs,
- removing humans from the manufacturing process.

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II. Analysis of Flexible Manufacturing Cell

At the Institute of Production System and Applied Mechanics is situated flexible manufacturing cell [2]. This flexible cell consisted of two subsystems (Fig.1a,b).

1. Cartesian robot
2. Shelf storage system

Five working phases is integrated in the flexible manufacturing cell:

- storage (storage of semi products, final products before its expedition),
- transport and manipulation (transport and manipulation with semi products and final products),
- manufacture (manufacturing of single semi products to the final product),
- assembly (assembly of single parts in to the one final product),
- expedition [3].



Fig.1a Flexible manufacturing cell



Fig.1b Flexible manufacturing cell

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III. Industrial robot with Cartesian kinematics

Very important part of the manufacturing cell is robot created from three axis, which are represented by three electrical driven actuators. Whole robot works in the Cartesian workplace. There are many elements, which are located at the working space of the robot [4].

- Special tool position used for automated tool changing system,
- Rotary unit,
- Pneumatic driven gripper,
- Grippers storage ,
- AHC unit,
- Tools storage.

Following to the conclusions and knowledge, which are coming from intelligent systems studies, were in the flexible manufacturing cell designed special added sensor units for each device. That means that every device will have its own sensor units, which will be used for processing of primal information. Such information ensures communication between single devices and control system. Before single sensor units specification, there was needed to specify requirements, which will be given to the designed intelligent manufacturing and assembly cell.

Designed intelligent cell have to be able to react on various situations which are coming during the manufacturing process [5]. Such as:

- React to the change of shape of manufactured or assembled part,
- React to the change of part dimensions,
- React to the usage or not usage of single subsystems by manufactured parts,
- React to the part types change,
- React to the change of technological parameters,
- Assurance of collisions situations at the cell,
- Low manufacturing costs,

During the design of intelligent cell, there was very important to conserve two basic subsystems, such as was during flexible manufacturing cell design.

At this contribution is resolved requirement of sensorial equipment at the cell workplace: „React to the part types change“. Cartesian robot must to operate different works. One of the main works is identification single specific elements types at the workspace of intelligent system from sensorial systems [6] .

IV. Sensorial systems

A. Sensorial systems in automation

Intensity and optimalization of the technological process (for example machinig) demands to cover a set of information about of technological system behaviour in machinig process, about interaction between piece and tool, and about changes of material properties in machinig process. For this reason continuous development of monitoring systems of cutting process is under way. Creation of monitoring systems is important especially in flexible production systems designing.

Monitoring systems are one of the most important devices for covering unfail operations and monitoring automatic production systems [7].

B. Individual parts of monitoring systems

For active control and cutting process regulation monitoring and regulation systems are used. Monitoring systems through the sensors which are placed on suitable place or element (machine, tool etc.) identify parameters, which are used as input data to computer algorithms. On the basis of these algorithms modification of technological, manipulating of additive process occurs. They are also used to correct production instruments function [8].

These are parameters such a mechanic vibration, acustic emission, torques, drive ouputs, cutting force, cutting temperature, tools wear, buckling, quality of piece dimensions and geometric shape.

Monitoring is related to subjects as machine, tool, process, tool and piece modification. Monitoring systems are important addition of new machines and control systems. On the present they have restricted structures, which are in the most cases derived from realized application and from the application purpose [9].

They consists of sensors and decoding device controlled by microprocessor. Today’s tendency is to integrate these systems directly to the machines. Sensors are basic instruments to information collecting and transformation of these information to set of primary signals. Principle of monitoring system integration is possible to see on the (Fig.2).

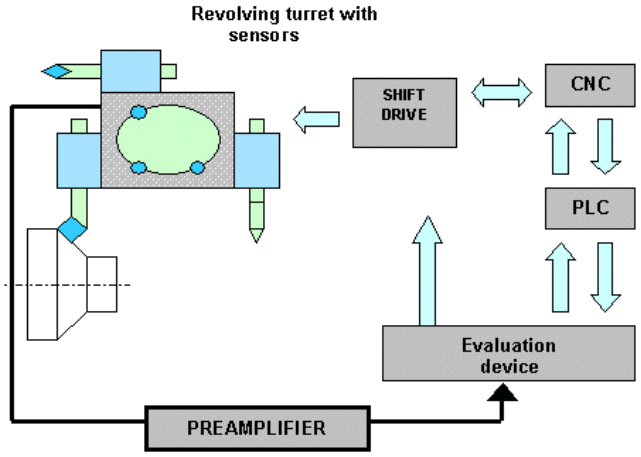


Fig. 2 Principle of monitoring system integration in cutting machine

C. Functions of monitoring systems

According to function monitoring is divided to:

Internal monitoring

It is part of production devices, robots and peripherals. It covers position scanning, servo-drives speeds, blocking of final positions. Model is on figure 1 with name principiale of monitoring system integration [10].

Add - on monitoring

It needs individual systems and subserves tasks as position identification, object orientation etc. On (Fig.3a) is

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identification of article with reflex light sensor and (Fig.3b) is reflex light sensor.

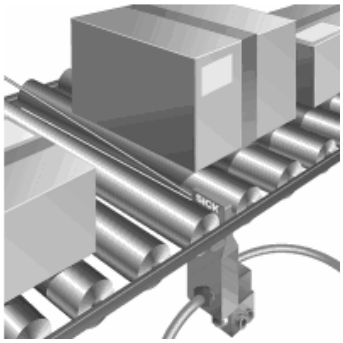


Fig. 3a Identification of article with reflex light sensor



Fig.3b Reflex light sensor

On the (Fig.4a, b) is identification of space objects.

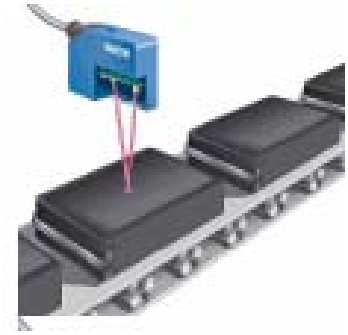


Fig.4a Identification of space objects

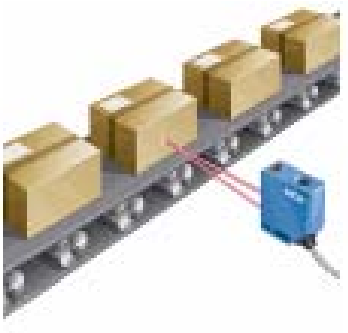


Fig.4b Identification of space objects

Safety monitoring

It is used to monitoring of production system proceeding, at unauthorized person entrance, production devices collision, power source fail etc. [1]. Fig.5a and Fig.5b are elektromechanical safety locks and safety sensors.



Fig.5a Elektromechanical safety locks



Fig.5b Safety sensors

D. Visual systems

In monitoring systems area is fast development of the add-on function obtaining. In this area are the most important systems, which subserve function of the human sense-organs, as vision, hearing, taction, scent.
Influential changes are noticed mainly at visual systems.
General application of visual systems is at:

- sort of object recognizing
- complicated movement controlling
  - surface automatic controlling
  - object sorting by characteristic signs
    - automatic cart navigation

On the Fig. 6a,b are monitoring (sensorial) laser systems on mechanical identification of position objects [4].

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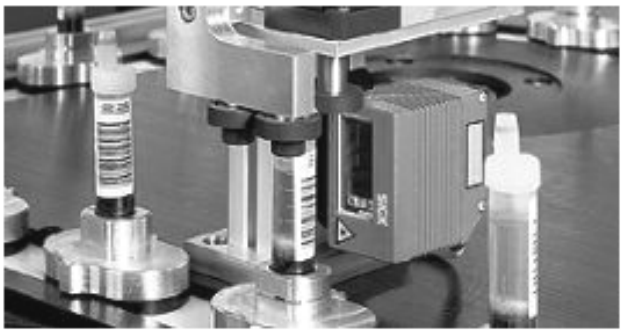


Fig. 6a Monitoring (sensorial) laser systems on mechanical identification of position objetcs



Fig. 6b Monitoring (sensorial) laser systems on mechanical identification of position objetcs

Visual systems imports are in solving of practical problem on the basis of human vision principles. Result of monitoring system development is the solution of the object identification problems, component inspection, welding heads leading etc. [3].

E. Tactile systems

In area of tactile functions is development oriented to problems about object relative position and about object shape and size. In area of the tactile monitoring systems development are noticed different approaches, which are derived from the possibility of the physical principle exploitation [4].

V. Designing of Sensorial Systems

A. Design on the basis of the production process technological part

Monitoring systems designing comes from analyse and specification of request of monitoring function requirement. This approach of monitoring systems designing comes from technological part of the production proces, which is necessary to monitoring system development.

Import of monitoring functions increases especially with level of production process automation, where is needed to elaborate questions relative to the manipulating and technological functions optimalization and to their cohesion with functions, which are realized by monitoring systems. Relations and requests of monitoring functions and their structures is possible to identify only following to exact analyse of the production process.

Solutions to demote requests of the monitoring functions are also realized. These solutions conduce to specifying of requests to construction of the peripherall devices and operating heads, which can eliminate requirement of monitoring functions.

More complex approaches to monitoring systems designing are described by basic phases:

- determine necessary monitoring functions
- determine suitable function parameters
- selection of suitable physical principle to construction or selection of sensors to parameter measuring
- selection of typical solution from data packet

B. Using of monitoring systems in automation

From position of application are monitoring systems used in technological process of welding, assembly and inspection activity.

From position of functions monitoring systems allow to identify of the shape, dimensions, position and orientation of production objects, to identify technical devices activity, to identify systems environs, controlling and blocking activities etc.

From position of construction solution development to small low price systems is applicable for area of automatic production instruments.

From position of mathematical methods using and software equipment, methods of object recognizing on the basis of artifficial intelligence are widely developed [6].

VI. Identification Single Specific Elements Types at the Workspace of Intelligent System

For identification of single elements types in the workspace of intelligent system, was designed identification system, which is using color sensing sensors. On the (Fig.7a,b) is color sensing sensors.



Fig.7a Color sensing sensor

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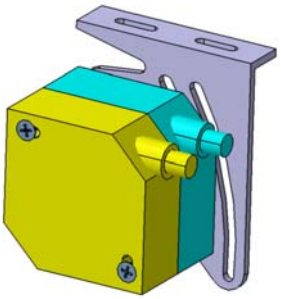


Fig.7b Color sensing sensor

This application is using two such sensors with type: SOEC-RT. Used sensor is able to sense three color kinds, which are then placed to the sensor memory. Individual elements are equipped by color labels [11].

Two sensors are sensing color label combination and so they are able to separate nine possibilities.

Example of such sensing is presented on the table1.

- sensors identification:
- color sensor 1: red, blue, yellow
- color sensor 2: red, blue, yellow

TABLE I SENSED COLORS COMBINATIONS

sensor 1	sensor 2
red	red
red	blue
red	yellow
blue	red
blue	blue
blue	yellow
yellow	red
yellow	blue
yellow	yellow

This alternative was designed for production at the assembly cell. In the future will by used for assembly pneumatics actuators – rollers (Fig.8a, b).

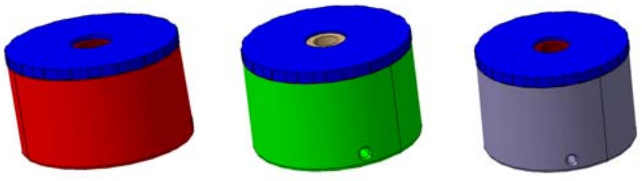


Fig. 8a Assembled pneumatic rollers



Fig. 8b Assembled pneumatic rollers

In the contribution is evaluated and selected suitable second alternative for identification – 2D codes reader (Fig.9).



Fig. 9 2D codes reader of type ICR845-2L FlexLens

2D codes reader advantages :

- flexible length of scanning from 0,1 mm to 3mm,
- replacement lens,
- the rapid transmission of the image etc.

At the intelligent assembly cell was used for assembly individual pneumatic rollers 2D codes reader and for production two color sensors

VII. CONCLUSIONS

Permanent increasing of automation level and optimization of automated manufacturing is conditioned by way of gathering and treating large amount of information about assembly objects, basic building elements, manufacturing processes and system environment. It appears, that necessary requirement for solution is implementing of machine intelligence elements to manufacturing process. To the basic elements of machine intelligence belongs visualization (monitoring), through which is possible to observe system status and changing conditions of environment.

To evaluation of present status in area of monitoring system creating is possible to approach from entire large range of aspects, which result from wide spectra of solutions.

Results of entire research of monitoring systems gain ground mostly in robotized systems field with machine intelligence and in basic technological processes. In term of application are monitoring systems applied mostly in technological processes of assembly, welding and inspection function [12].

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