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METHODOLOGICAL PROCESS FOR CREATION OF PALLETIZING – ASSEMBLY WORKPLACE

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МЕТОДОЛОГІЧНИЙ ПРОЦЕС СТВОРЕННЯ ПАКЕТУВАННЯ – МОНТАЖ НА ВИРОБНИЧОМУ ПРИМІЩЕННІ

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МЕТОДОЛОГИЧЕСКИЙ ПРОЦЕСС СОЗДАНИЯ ПАКЕТИРОВАНИЯ – МОНТАЖ НА ПРОИЗВОДСТВЕННОМ ПОМЕЩЕНИИ

Methodological process for creation of palletizing – assembly process with industrial robot using is the main idea of this article.It is important to define basic structure of the palletizing - assembly workplace with deployment of industrial robot, motion sequences methodologies for building of palletizing - assembly workplace based on the modular principle in order to create various structures such workplaces. In order to achieve a high degree of autonomy, this article is based on findings modularity of basic building blocks these workplaces.

Key words: *methodological process, assembly objects, modular, design.*

Fig.: 6. Bibl.: 9.

Основною ідеєю цієї роботи є методологічний процес створення пакетування – процес складання з використанням промислового робота. Важливо визначити основну структуру пакетування – монтаж на робочому місці з розгортанням промислового робота, руху послідовностей методології побудови пакетування – робочого місця для збірки на основі модульного принципу для створення різних структур таких робочих місць. Для досягнення високого ступеня автономії, ця стаття заснована на результатах модульности основних будівельних блоків таких робочих місць.

Ключові слова: *методологічний процес, складальні об'єкти, модульний, дизайн.*

Рис.: 6. Бібл.: 9.

Основной идеей данной работы является методологический процесс создания пакетирования – процесс сборки с использованием промышленного робота. Важно определить основную структуру пакетирования – монтаж на рабочем месте с развертыванием промышленного робота, движения последовательностей методологии построения пакетирования – рабочего места для сборки на основе модульного принципа для создания различных структур таких рабочих мест. Для достижения высокой степени автономии, эта статья основана на результатах модульности основных строительных блоков данных рабочих мест.

Ключевые слова: *методологический процесс, сборочные объекты, модульный, дизайн.*

Рис.: 6. Библ.: 9.

Introduction. Palletizing – assembly workplace consists of a pallet conveyor, assembly objects, and robot. The robot approached positions that control program based on parameters derived from assembly object properties and sensory systems used in palletising is calculated in advance. For monitoring the whole process is necessary to use complex sensory systems. Palletized may be different or the same assembly objects, including, in the case of different shapes or different. On that basis is generating algorithms and depend on their complexity [1].

Regards to the variety of assembly objects, assembly operations, and diversity of other factors, the structure of flexible assembly workplaces are highly diverse [2]. The basis for construction is modular units and other equipment including programmable assembly units, robots and manipulators, supply and transport equipment, control units etc.

Palletization methods can be divided into:

– 1D palletization: It is sorting of assembly objects on a pallet in one direction. In this type of robot palletization which uses a simple robot control of one recalculation of coordinates - other coordinates are in each cycle still constant. Palletizing is done by either horizontally or vertically direction.

– 2D palletization: Assembly objects are stored on a pallet in two ways. Two coordinates are changing and the third remain constant. This palletizing is used when we create pattern layout of objects in a single layer.

– 3D palletization: 3D palletizing used also third coordinate for storing assembly objects. It uses a process in which pattern is formed in the 2D palletizing, and then this pattern is repeated in several layers on each other. It may vary in individual layers. In this type of palletization is very into account the stability of objects that are stored on a pallet [3].

In design of palletizing - assembly workplace we start from fact that actual logistics chains, therefore conveying lines are already designed, it means that we know:

– sequence the logistics chain,
– transport time,
– layout of conveyor lines,
– input and output of conveyor lines and their construction.

Block scheme for methodological process for creation of palletizing – assembly workplace can be seen at Fig. 1.

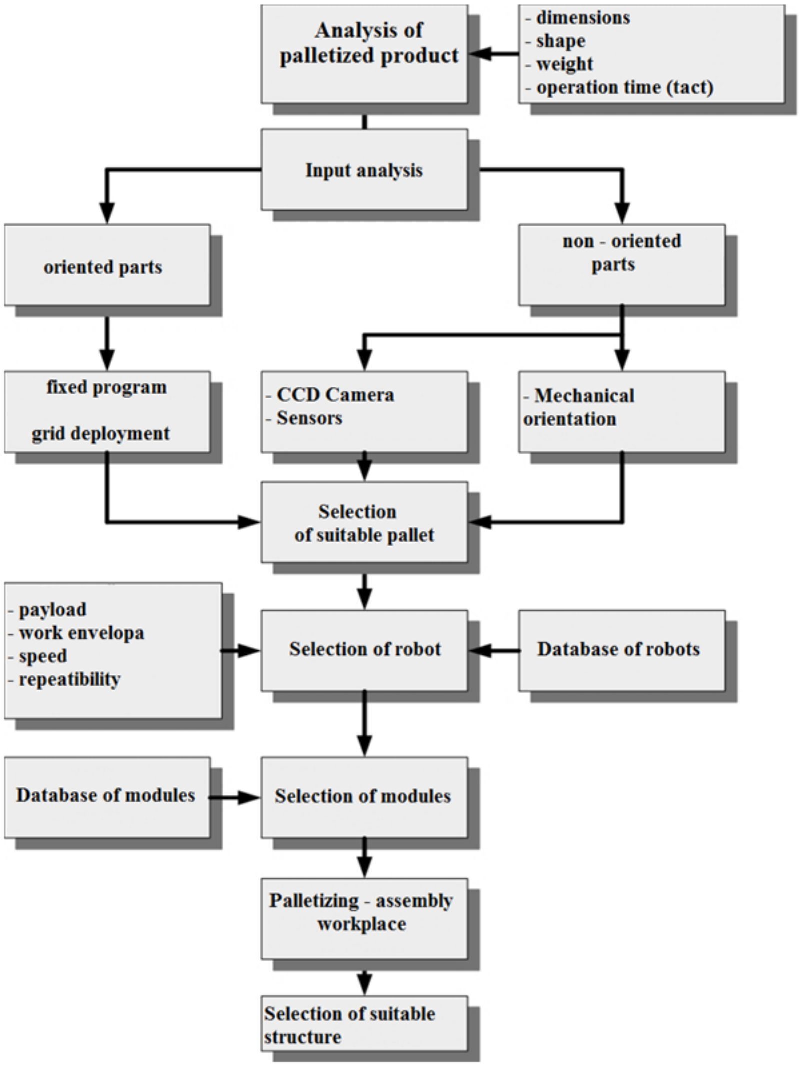

Fig. 1. Block scheme for methodological process for creation of palletizing – assembly workplace

Selection of stored objects on the palette. The most important construction data which are examined in the creation of object base include: geometric shape, size, weight, material, intermediate form etc. For technological data are during analysis of assembly object base most often analysing the type of technological operations and involved work [4]. Model of assembly object base can be determined by production capacity of robotized workplace for:

– individual operations,
– assembly objects,
– workplaces and whole manufacturing system.

When choosing a method for storing of assembly objects to pallet for a variety shape of components it is mainly about their planar arrangement on a support surface of system palette. It is implemented in a way to keep them stabilized (fixated) position during the section of palletizing - assembly process in which it is necessary to change the orientation of assembly objects or changes its static position [5].Components should be stored on a pallet in such way so distance between assembly object and pallet was as large as possible and to focus on object was placed in the smallest possible distance from the support surface of palette.

Picture 2 shows the various grid types for regular arrangement of assembly objects on a pallet, at picture 3 shows possible way for variety assembly object storing on a pallet.

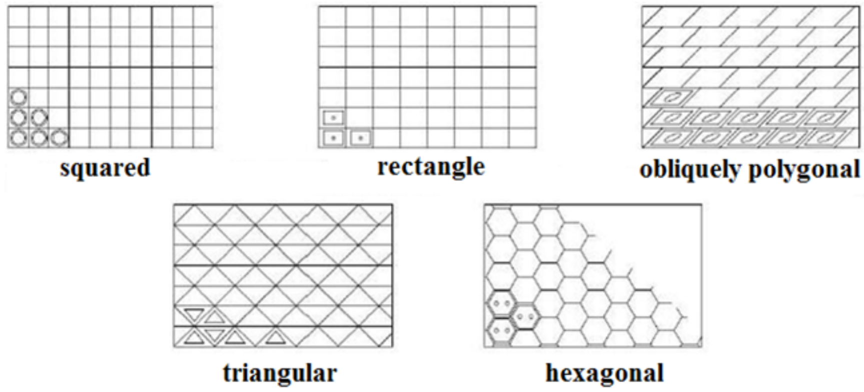

Fig. 2. Grid types

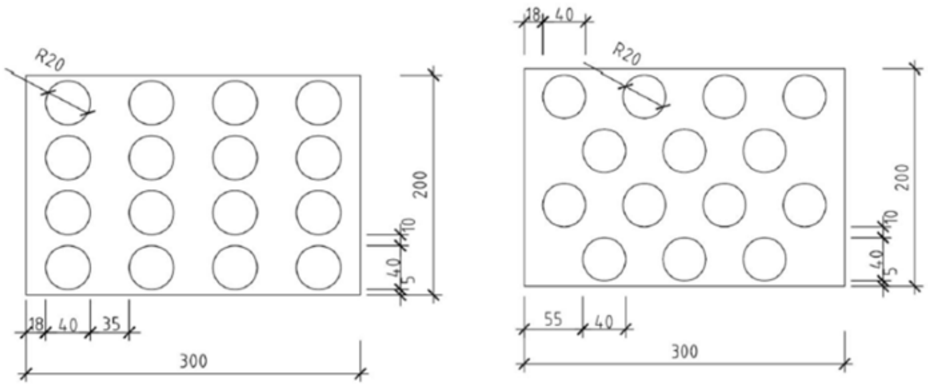

Fig. 3. Possible way for variety assembly objects storing on a pallet

Input of assembly objects. Input of assembly objects to the palletizing - assembly workplace is first step from the series of individual operations, without which palletizing - assembly process was not possible. Assembly objects are basic building components of final product [6]. So, it is necessary to provide a flexible transport system which allows you to input and output to and from the workplace as soon as possible. Components have to be during inputting into workplace required orientation, so, it is necessary to orient them through suited equipment by orientation elements that are placed in lanes of vibratory trays. Picture 4 shows vibratory tray and different paths and slides [7].

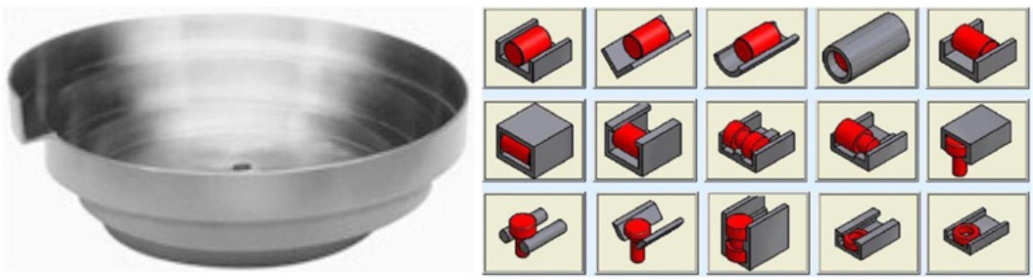

Fig. 4. Vibratory tray with different paths and slides

Selection of an industrial robot. The selection of an industrial robot plays an important role in design process of palletizing – assembly workplace. It results from suitability of specific types of robots for various applications occurring in the manufacturing process. Picture 5 shows a methodological process for selection of an industrial robot.

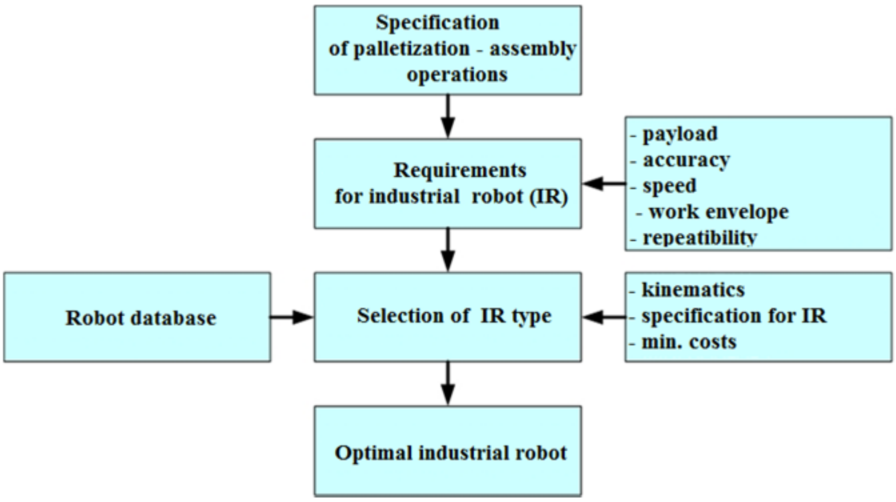

Fig. 5. Methodological process for selection of an industrial robot

For applications in palletizing - assembly process is the most appropriate types of robots SCARA type and linear (Cartesian) types of robots [8].

Selection of gripper. The most widely used effector for robots are gripper's types to securing the grasping of manipulation object, its stable position on movement and the release of next manufacturing operation[9].From a structural point of view can define from gripper following separate components:

1. Energy source – in choosing the appropriate type of gripper, we must take care that such source of energy for our applications suitable to power him. It is preferable to choose such an energy source which is powered by a robot. E.g. if robot is electric, it is suitable to choose electrically driven gripper.
2. Transmission mechanism of movement – most important requirements for transmission mechanism of movement is requirement to link between distributions of gripper working parts, ant it is in case of need to centre for assembly object.
3. Outputs of parts - basic output elements include: interchange ability (fixed and removable), number of jaws.

Picture 6 shows 2, 3 and 4 fingered grippers.

Fig. 6. Grippers regards to type of jaws (fingers)

Conclusion. The aim of this article is to create a methodological process for designing of palletizing – assembly workplace. Article emphasizes to the designer for importance of individual components of workplace. As such, compatibility is one of the factors without which the creation of variant structures not is possible. With increasing degree of automation is also growing demands on the intelligence of palletizing - assembly workplace. The paper shows methodology for designing of palletizing - assembly workplace by using principles of modularity and integrated vision sensor system to the increasing intelligence of such workplaces.

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References

1. Hajduk, M., Baláž, V.: Palletization with robot OTC Daihen. In: Mašinostrojenijeitechnosfera 21 veka :sborniktrudov 16 meždunarodnojnaučno-techničeskojkonferencii : 14-19 centjabrja 2009 g. v gorodeSevastopole. Tom 4. - Doneck : DNTU, 2009. - 1 elektronický optický disk (CD-ROM).

2. Hajduk, M.: Pružné výrobné bunky. Košice : Vienala, 150 s.

3. Tolnay, M.: Manipulačné a dopravné systémy. 2006. STU. Bratislava. 18 - 22 s.

4. Bryan, a.: Co-evolution of product families and assembly systems, The University of Michigan 2008.

5. Michelini, R., Acaccia, G., Callegari, M., Molfino, R., Razzoli, R.: Computer-Integrated Assembly for Cost Effective Developments, CRC Press LLC/Lewis Publishers, BOCA RATON, USA, 2001.

6. Frei, R., M.: Validation of Requirements for attaining Evolvable Assembly Systems and a preliminary methodology for the modularisation aspects, EPF Lausanne / KTH Stockholm / DU Borlänge, 2005-2006.

7. Mazurek, L., Taranenko, V.: Holes processing and classification in automated technological process projecting system. In: ActaMechanicaSlovaca. ISSN 1335-2393, 2006, roč. 10, č. 2-A ROBTEP, s. 325-330.

8. Semjon, J.: Využitie princípov modularity a rekonfigurovateľnosti pri stavbe zváracích prípravkov. In: ActaMechanicaSlovaca. - ISSN 1335-2393. - Roč. 12, č. 2-A (2008), s. 561-564.

9. Havlík, Š., Hricko, J.: The RCC mini-gripper for precise assembly. In Modern Machinery Science Journal: 20th International Workshop on Robotics in Alpe-Adria-Danube Region. - 2011, special edition, p. 128-133.

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