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USE OF THE OMRON F150-3 CAMERA FOR THE POSITIONING OF RANDOMLY DISTRIBUTED PARTS

The article discusses the development of a testing workplace for the handling of 3D objects. The workplace is equipped with an industrial SCARA robot, an intelligent input conveyor, pallet and depalletizing equipment, a vibrating feeder and vibrating trays, switch effectors, universal gripper, and other components. The workplace is also equipped with two OMRON F150-S1 cameras, which are used to create a 3D camera system. The article describes how the 3D camera system is used to determine the position of objects on the conveyor belt. The system first uses the density averaging function to determine the average optical density of the region without any objects. This value is then used as a threshold to determine whether an object is present in the workspace. If an object is present, the system uses the gravity and area functions to calculate the X and Y coordinates of the object from the center of the measuring platform. The system then uses the edge position function to calculate the Z coordinate of the object.

Keywords: *robotic workstation, 3D camera, manipulation of unoriented objects*
Fig.:3. Tables.:1. References:8.

Relevance of the research. Orientation of parts using a 3D camera is a current topic because it has many advantages over traditional methods. 3D cameras are able to determine the orientation of parts with high accuracy, which is important in applications such as manufacturing and assembly. 3D cameras can orient parts quickly, which is important in applications where a large number of parts need to be processed. 3D cameras can be automated, meaning they can be used to orient parts without human intervention. This can save time and money. 3D cameras can be used to orient parts of different shapes and sizes.

Problem statement. Current methods of component orientation have a number of disadvantages. Manually orienting parts can be time-consuming and not always accurate. Traditional methods of automatic part orientation are often limited to certain types of parts and cannot be used to orient parts of different shapes and sizes.

Analysis of recent research and publications. The OMRON F150-3 camera is a 3D camera that is commonly used for the positioning of randomly distributed parts. It has a number of features that make it well-suited for this application, including:

- A high resolution, which allows it to accurately capture the shape and orientation of parts.
- A wide field of view, which allows it to capture multiple parts in a single image.
- A fast frame rate, which allows it to capture images of moving parts.

A number of recent research papers have been published on the use of the OMRON F150-3 camera for the positioning of randomly distributed parts. These papers have investigated a variety of methods for using the camera to determine the position of parts, including:

- Feature-based methods: These methods use the features of the parts, such as their shape or size, to determine their position.
- Background subtraction methods: These methods use the background of the image to determine the position of parts.
- Template matching methods: These methods use a template image of the part to determine its position [1,2].

Uninvestigated parts of a common problem. Despite the progress that has been made in this area, there are still areas that are not sufficiently explored. For example, researchers are still working on developing methods to orient parts that are resistant to adverse conditions such as dust, moisture and light. Researchers are also working to develop methods to orient parts that are affordable and easy to use.

Research objective. The goal of this research is a new method for part orientation using 3D cameras that will be fast, sufficiently accessible and affordable. The new method will be based on a combination of traditional and new methods and algorithms. The method will be tested on different types of parts under different conditions.

The statement of basic materials. Recently, more and more frequently we encounter rapid development in the field of automation of cyclically recurring processes. These processes occur not only in the deployment, but also in our daily lives. Most of us about them or just have no idea, and it has long since become a normal part of our. The camera systems, cyclically repeated steps: getting data from the source, their processing and evaluation in real time, and last but not least activity depend on the evaluation thereof. These steps we've taken advantage of in the construction testing workplace for the handling of 3D objects created in the project: applied research systems smart handling of industrial robots with unoriented 3D objects. Visual sensor subsystems are an essential part already or not adaptive, but directly to autonomous complex mechatronic systems. Their integration into the production cycle, the monitoring of technological processes and operations increases flexibility, production flexibility and partially eliminating the need for human intervention [3].

Equipment of research workplace Robotics research workplace serving for verification of selected types of methods and algorithms of randomly oriented objects. The main parts of this workplace include the following components:

- Industrial robot Scara
- Intelligent input conveyor
- Pallet respectively Depalletizing equipment
- Vibrating conveyor and vibrating trays
- Replacement of equipment effectors and universal gripper
- Other components (control computer, PLC control, rotary actuators, linear and rotary modules)

The structure of the research robotic workstation (fig. 1 and fig. 2) consists of industrial SCARA robot, intelligent input conveyor, pallet and depalletizing equipment, vibrating feeder and vibrating trays, switch effectors and universal gripper and other components (control computer, PLC control, rotary actuators, linear and rotary modules) [4].

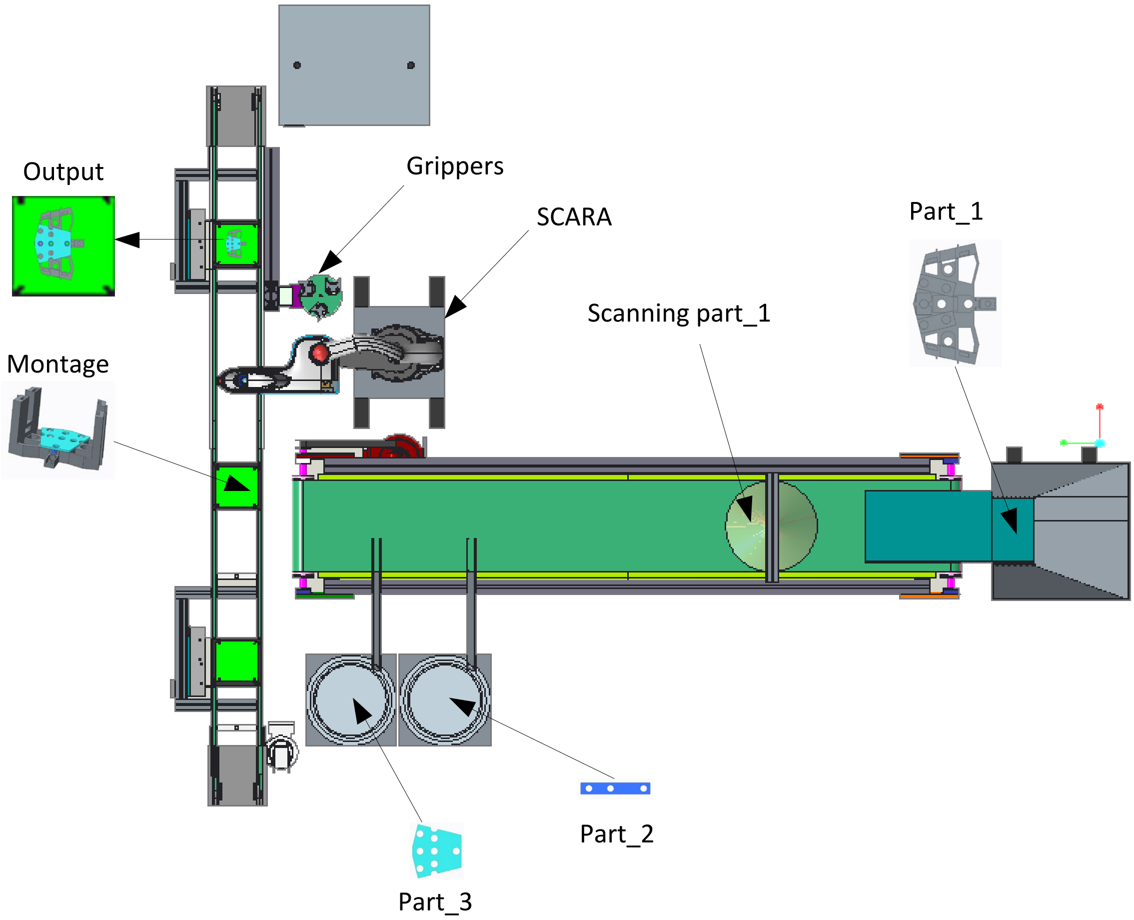


Fig. 3. Layout of research workplace

The aim of the establishment of the research department is the possibility of using it, inter alia, in at teaching process for the preparation of students in the field of Robotics and automation. Provides the ability to use for experimental and research purposes and significantly contributes to the preparation of students for practical as well as a better theoretical page [5].

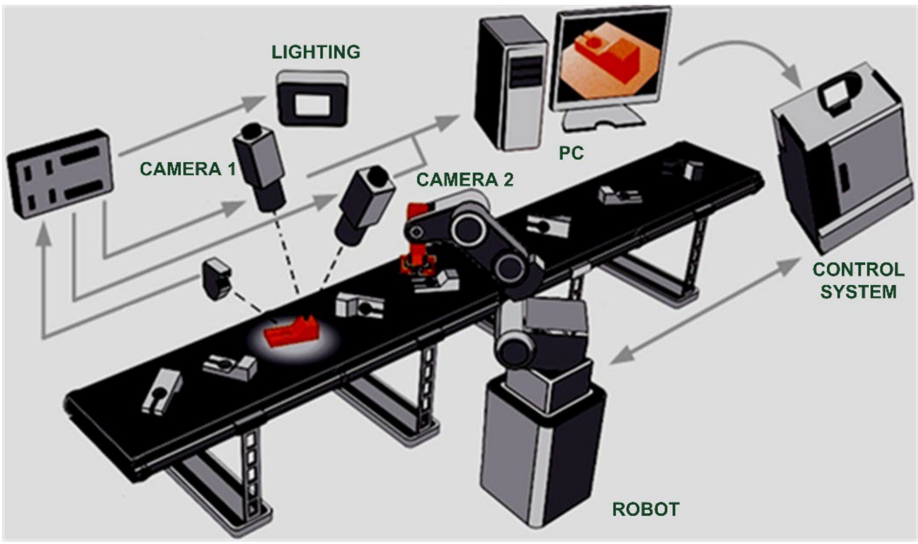


Fig. 4. Layout of research workplace

As shown in fig. 2, handling variously oriented subjects in the area of one camera is not enough. For this type of application must be built. 3D camera system while may be issued in two ways. Either purchase industrial 3D camera with evaluation software or a combination of two or more cameras to create a 3D system in which using geometric relationships relevant coordinates of the object in space are extracted, calculated [6].

A crucial and critical place of each visual system specific parameters of the cameras. On the test facility are used cameras OMRON F150-S1, Fig. 3, which have the following main parameters.

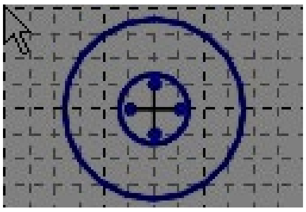
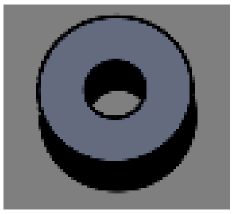
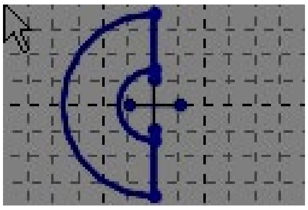
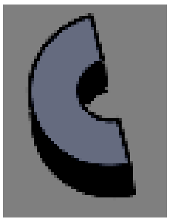
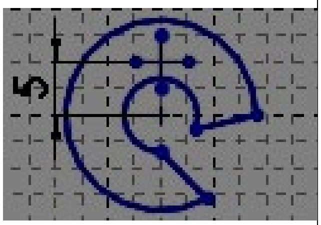
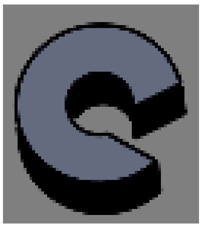
- resolution camera system :512 (H) x 484 (V), and the camera 659 (H) x 494 (V)
- focal length: 35 mm
- The range image depending on whether the camera is mounted on an intelligent light source, the distance of the measurement object from the camera and use the spacer - additional intermediate links between the lens and the camera itself.

Fig. 5 Camera OMRON F150-S1

Visual inspection system OMRON F150-3 has 16 scenes (one measuring stage for one component together so settings can be saved for up to 16 products), has the option to record in the memory up to 32 images controlled subjects and 16 measurement functions. Because of the manipulation necessary to ascertain the position of the object on the conveyor belt. To determine whether the object whose coordinates we need to identify the center of gravity is not at work, the scene measuring function is used Density averaging based on the difference in the brightness of the image units. As part of this exercise will evaluate the density of each pixel based on its brightness (values from 0 to 255, so. Grayscale, gray scale), calculate the overall average for crawled area (search region) and on the basis of the calculated measurement made [7].

At the beginning of measurement made for the empty stage to determine what is the average optical density of the region without building measurements. The measurement showed that under the given lighting conditions, the average optical density of the searched area bounding box is equal to the value of 64.525. In the next step, access to the operation which is referred to as thresholding - we define thresholds, under which the system will be able to say with certainty whether the component in the workspace is present or not. In implementing the thresholding operation, thus entering the limit values for separation of compliant products from spoilage, the following procedure was followed: The verdict OK was set to 100 for objects with a correlation value of 84 or higher with the reference object. All objects with measurement values of 83 or lower were marked as error parts, as shown in, tab. 1.

Tab. 1 Example of correlation products with the reference object

Component	Leayout	3D model	Corelation
reference component			**100**
component 1			**50**
component 2			**40**

After calibrated measuring range to the display poles we can move to the measured X and Y coordinates of the selected object from the center of the measuring platform, from the bottom left corner of the screen within the external coordinate system use the function Gravity and area. The said function can calculate the mean of the sheet object (top view), provided that the recognized object is formed on the screen, a preponderance of white pixels and the rest of the scene is black.

To extract the coordinates of the third applies the function "edge position", a feature that can detect the edges of objects and their position is considered sufficient contrast between the background and object recognition. As with the deployment tool "Gravity and area" We have to edit the scene through BGS - background suppression (post-processing, image processing after receipt) so that between the edge and the background is visible difference. The background is cut off, so to speak, determines the upper and lower limits (0 to 255) pixels and brightness only areas covered by this difference of the measurement are taken into account. If the position of the side edge is to be measured, the product is selected in the desired direction. If the subject is dark and the background is light, the "Light to Dark" option is chosen. Of course, before drawing, the area where the edge of the object in question should be located is defined. [8].

To perform a test, the standard deviation measurements for X - coordinate was 0.015, 0.064 for Y, Z for 0,009. The cause of the greatest deviations of measurements for the Y - coordinate maybe fact that has not been used for measurements intelligent light source, measured in scene and lights steadily and the results achieved probably be relevant effect lighting in the premises of the laboratory of a relatively large vertical distance of the camera from the object of measurement.

Conclusions. Practical verification, we found that camera system OMRON F150-3 is applicable to the assembly lines with sufficient accuracy without special lighting. The next step in addressing the interconnection of the camera system and robot who will take part and classes.

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ВИКОРИСТАННЯ КАМЕРИ OMRON F150-3 ДЛЯ ПОЗИЦІОНУВАННЯ ВИПАДКОВО РОЗПОДІЛЕНИХ ДЕТАЛЕЙ

У статті розглядається розробка тестового робочого місця для роботи з 3D об'єктами. Робоче місце оснащене промисловим роботом SCARA, інтелектуальним вхідним конвеєром, обладнанням для палетування та депалетування, віброживильником та вібролотками, ефекторами перемикачів та універсальним захватом та іншими компонентами. Також робоче місце оснащене двома камерами OMRON F150-S1, які використовуються для створення системи 3D камер. У статті описано, як система 3D-камер використовується для визначення положення об'єктів на конвеєрі. Система спочатку використовує функцію усереднення щільності, щоб визначити середню оптичну щільність області без об'єктів. Потім це значення використовується як порогове значення для визначення наявності об'єкта в робочій області. Якщо об'єкт присутній, система використовує функцію гравітації та площі для обчислення координат X і Y об'єкта від центру of the measuring platform. The system then uses the edge position function to calculate the Z coordinate of the object.

Ключові слова: *роботизована робоча станція, 3D-камера, маніпуляції з неорієнтованими об'єктами*

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