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BLACK SEA SCIENCE 2020

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3. INFORMATION TECHNOLOGIES, AUTOMATION AND ROBOTICS

VICTORY MANIPULATOR UNIVERSAL ROBOTS IN THE LINE SORTING OF FINISHED PRODUCTS OF THE WINE INDUSTRY

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Abstract. *The work considers the introduction of collaborative robots (manipulators) into the line of the technological process for the bottling, drying and packaging of sparkling wines, for safer work of people with manipulators and to reduce accidents at the plant itself.*

Key words: *collaborative robots, industrial manipulators, production safety, technological process, engine failure.*

Introduction

Production safety - to this day they are striving for this. Initially, the human muscle was replaced by mechanical, which simplified the work of man. For example, turning a part on a lathe, a turner - in this case operates with a process, since all the work on rotating the part is performed by an electric motor. But even this work is not completely safe, there are many accidents during such work.

As a result of scientific and technological progress, the mechanical work of man was replaced by automation, that is, the cleansing abilities were performed by program-logic controllers, and not the human mind, where he was in the operator's room and controlled the technological process through a computer.

How many methods are used for the safety of production, for example, at elevators (cereals, sunflower seeds, corn) and flour mills, since a large amount of dispersed dust is released, an explosion occurs when a spark appears. This is avoided by removing dust from the walls of the enterprise. By similar parameters, in chemical plants where vapors can explode, they are also diverted from the process itself. In addition to such productions, use pneumatic or hydraulic actuators, since they do not give a spark.

Most enterprises use conveyors, like other moving elements, they can easily tighten the limbs of a person who, in turn, did not adhere to safety precautions, so that as soon as possible to stop the conveyor, a cable is attached to its base, if it is pulled, it will trigger the end a switch that will operate as a lock and the conveyor will stop.

The use of manipulators in industry is very common, for example, in automobile manufacturing, without them large-scale production of products did not exist. Also, manipulators can be used in the food industry.

Analytical analysis of the literature

We have considered a large number of publications by various authors exploring this issue.

The production line and its sparkling wine champagne process are discussed below[1, 2, 3].

Object, subject and research methods

Field of application of "Universal Robots" collaborative manipulators in the wine industry. Let us single out a section of technological production for the use of collaborative manipulators (robots). By those. The process will be a sparkling wine production site.

General process analysis

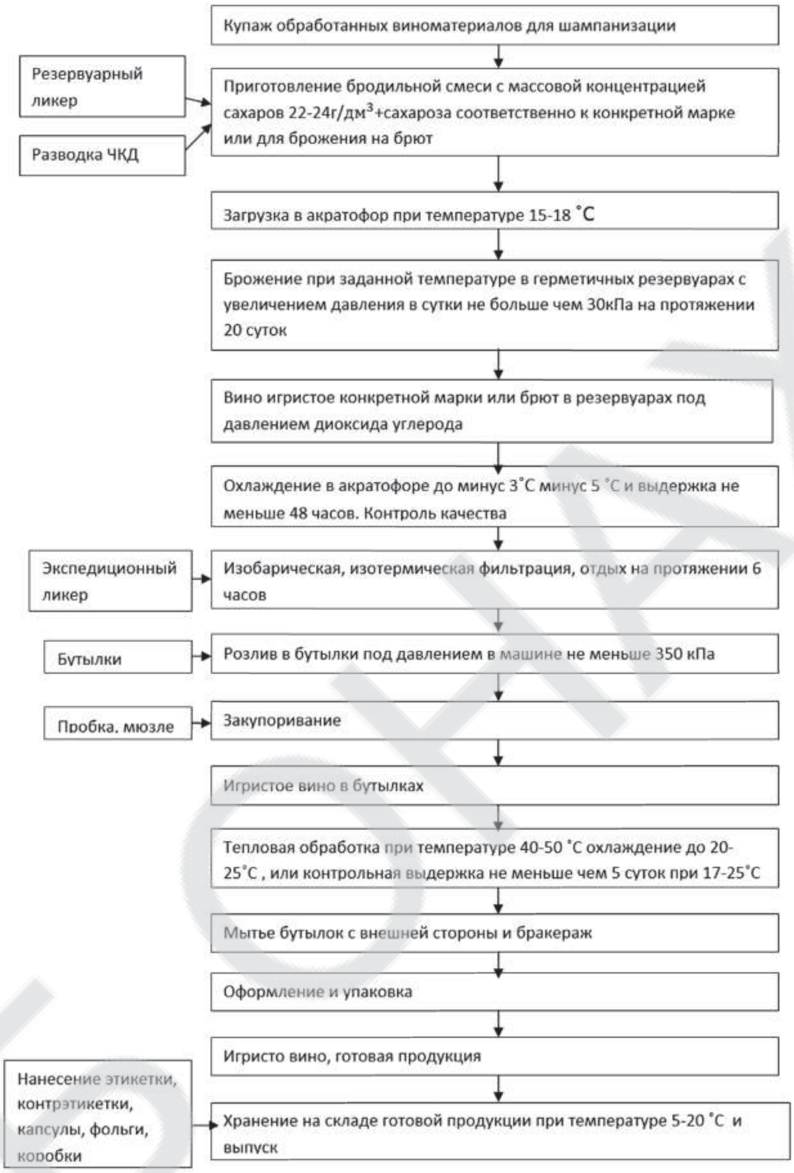

Image 1. The technological process of champagne wine

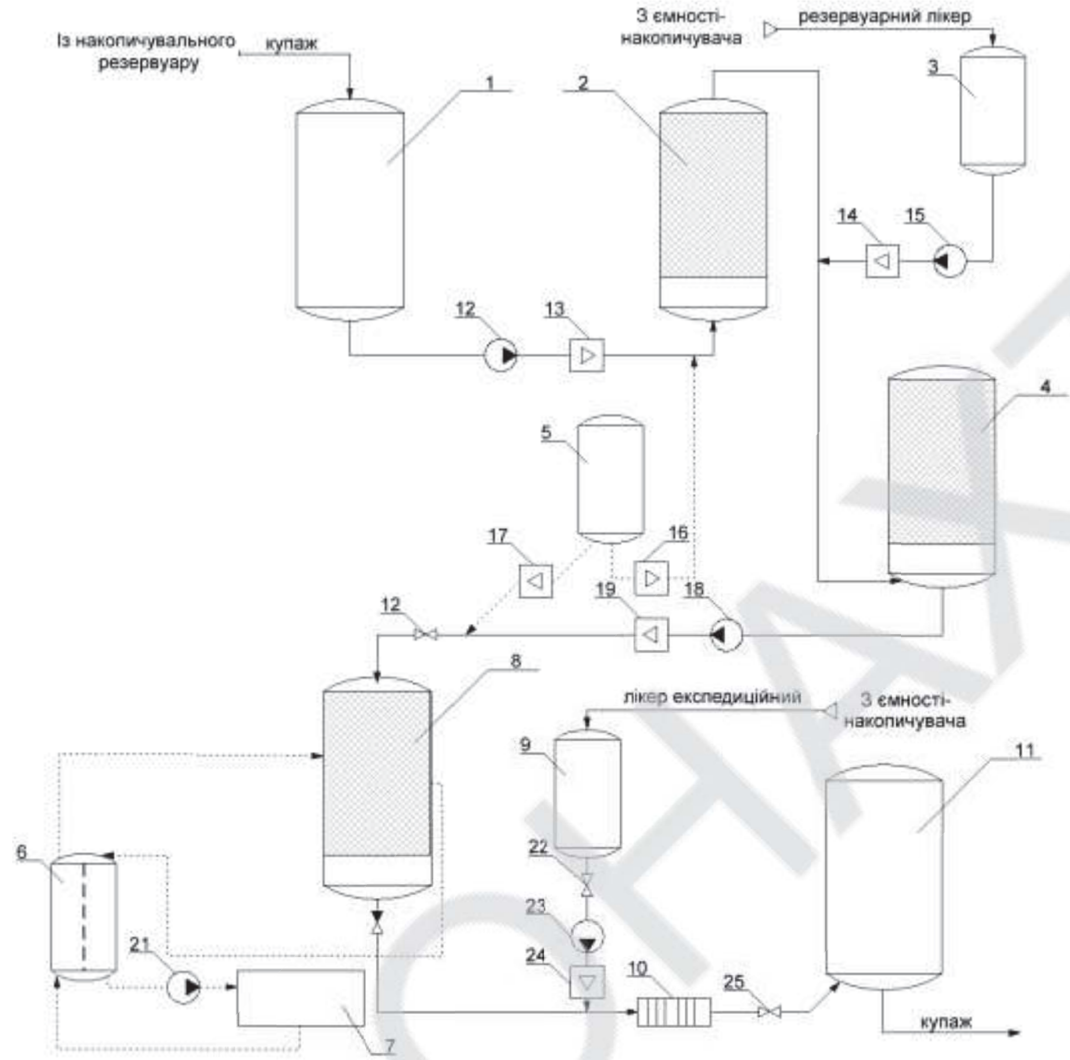

Image 2. Flow diagram of a section of a line for production of sparkling wines

The blending from the reservoir (1) by the pump (12) through the flow meter (13) is supplied to the apparatus (2) with the filler. Simultaneously with the blend, yeast wiring with dispersed mineral and yeast-growing apparatus is injected into the stream (5).

In the apparatus (2), processes of deoxygenation, stabilization and filtration of the blend occur.

Further, the worked blend is fed into the storage tank (4) for preparing the fermentation mixture by supplying the land (3) to the tank liquor stream using a pump (14) through a flow meter (15).

The fermentation mixture is pumped with a batcher (18) through a flow meter (19) and stop valves (20) into the acratophore (8) with a filler for the process of champagne. The fermentation mixture is dosed yeast wiring cultured with dispersed mineral.

At the end of the secondary fermentation, the sparkling wine is cooled, dispensed in the stream by expeditionary liquor from the tank (9), by opening the shut-off valves (22) of the pump (23) and the flow meter (24). It is filtered on the filter (10), through the stop valves (25) it enters the receiving unit (11) and enters the bottling.

The refrigerant from the tank (6) is pumped to the refrigeration machine (7) by a pump (21). It cools, enters the reservoir (6) and enters the pipe system, which are connected with the acratophore jacket (8), the spent refrigerant returns to the reservoir (6).

The use of cobots "Universal Robots"

After bottling and corking the bottles, they move along the conveyor to the sink and sent to the packaging. On the way to the packaging, filled bottles with sparkling wine are checked for defects, that is, they are illuminated by a laser with a special sensor on the one hand, and on the other hand, the receiving part of the sensor analyzes the density of the signal beam from the laser, if the signal is weak, then the bottle filled with wine, but suddenly the signal turns out to be stronger, then the density is lower, which in turn means that the bottle is empty, maybe the dispenser did not fill it. In any case, it is impossible to pack a defective product with a full one.

It is necessary to eliminate it from the conveyor, for this the manipulator (robot) “Universal Robots” of the UR10e model series is suitable, since they are safe when working with people. Since there is a washing, a marriage check, a label sticker and the packaging itself, which most people can do, is located in the workshop. The use of conventional manipulators can lead to injuries to people at work in cramped workshops, as they do not provide protection.

In cobots “Universal Robots” protection is provided for working with people, for example, when it is working, it accidentally touches a person, the robot instantly stops and will wait for some time according to the algorithm or already an operator’s command to continue working, which will give time to a person , which hit, leave this place.

Consider a line of collaborative robots, which consists of four instances (shown below).

A brief description of the line e-series: created with a view to the future, the e-Series line allows you to expand your business, is a springboard to improving quality and increasing productivity, helping you always get ahead of your competitors. With an intuitive programming option, versatile use and an endless list of accessories, the e-Series line fits harmoniously into production regardless of industry, company size or product nature.

Universal Robots “UR3e”

Image 3. Universal Robots UR3e

Specification

- Radius – 500 mm / 19.7 inch
- Payload – 3 kg / 6.6 lbs
- Footprint – ø 128 mm
- Weight – 11.2 kg / 24.7 lbs

Universal Robots “UR5e”

Image 4. Universal Robots UR5e

Specifications

- Radius –800 mm / 33.5 inch
- Payload – 5 kg / 11 lbs
- Footprint – ø 149 mm
- Weight 20.6 kg / 45.4 lbs

The latest offering in our collaboration robot series, UR5, extends the capabilities of agents ready for future change with collaborative innovation, Human Centric UX, and the ecosystem for each application. Transform ambition into results by changing the way you manufacture using the most flexible automation platform.

Universal Robots “UR10e”

Image 5. Universal Robots UR10e

Specifications

- Radius – 1300 mm / 51.2 inch
- Payload – 10 kg / 22 lbs
- Footprint – ø 190 mm
- Weight 33.5 kg / 73.9 lbs
-

Universal Robots “UR16e”

Image 6. Universal Robots UR16e

Specifications

- Radius – 900 mm / 35.4 inch
- Payload – 16 kg / 35.3 lbs
- Footprint – ø 190 mm
- Weight 33.1 kg / 73 lbs

Universal Robots “UR16e”, a recently released novelty that expanded the e-series family, one of the main differences from the “UR10e” is the reduced range from 1300 mm to 900 mm, but this is offset by an increase in carrying capacity by 6 kg, for example, “UR10e” - 10 kg vs “UR16e” - 16 kg, also “UR16e” became 400 grams lighter than its predecessor.

Consider an analogue of the Universal Robotics

ROZUM Robotics model 90

Image 7. PULSE 90

Specifications

- Payload – 4 kg
- Radius – 900 mm
- Weight – 13.6 kg
- Footprint – 120 mm
- Non-Stop lifetime cycle – 20000+ hours

In this work, it will be rational to choose a collaborative robot “UR5e”, since the maximum weight of the bottles will reach 3.5 kg, it would also be better to use the kobot “UR10e” in the radius of use, but for the work area, “UR5e” is enough, in addition, a larger radius may be needed only in isolated cases, it will not be necessary to overpay for a more expensive modification if it does not work out at 100 percent.

One of the main differences and arguments for using cobots of the “Universal Robots” from their counterparts is the safety of working with people around, for example, if a person touches him while the robot is working, the cobot will stop and wait for further action or according to the algorithm it will work after a specified time further

Also, the presence of the robot itself is not sufficient to realize its full functionality - grips are additionally used (we will consider below different analogs of grips that have unified mounts for a universal platform of colorative robots).

Image 8. Grip WSG25-CR

Specifications

- Compliance with safety requirements for human-robot interactions
- Quick integration
- Built-in web interface with documentation for configuration and diagnostics
- Support for textual communication protocols over TCP / IP and UDP, as well as the industrial Modbus / TCP interface
- Grip control directly by the robot controller via the integrated Modbus / TCP interface

Grip integration without the need for programming. The built-in controller uses the latest capture algorithms, high-speed object detection and capture control.

External position sensors are no longer required since position measurement is carried out using internal sensors. This simplifies the process of integrating a robotic solution into your manufacturing process.

Image 9. OnRobot RG2 Gripper

Specifications

- Easy installation
- Integrated control board
- Flexible, easy to reconfigure
- Support for two grips simultaneously
- Adjustable force
- Wide working range, work with objects of different sizes
- Fast change of fingers of capture
- Plug & play
- Easy programming
- Retention of gripping force in case of power loss
- Analog Robot Feedback

Adjusting the grip force allows you to hold both light and heavy objects. Standard fingers can be used with many different objects. Installation on capture of third-party fingers is possible. Configure and control capture from Universal Robots software. Technical specifications are shown in the image 10.

Параметр	**Мин.**	**Типичное**	**Макс.**
Полный ход (регулируемый)	0	-	110 мм
Точность позиционирования захвата	-	0,1 мм	-
Повторяемость	-	0,1 мм	0,2 мм
Обратный люфт	0,2 мм	0,4 мм	0,6 мм
Сила захвата (регулируемая)	3 Н	-	40 Н
Точность силы захвата	±0,05 Н	±1 Н	±2 Н
Скорость захвата	55 мм/с	110 мм/с	184 мм/с
Время захвата	0,04 с	0,07 с	0,11 с
Рабочее напряжение	10 В	24 В	26 В
Потребляемая мощность	1,9 Вт	-	14,4 Вт
Максимальный ток	25 мА	-	600 мА
Рабочая температура окружающей среды	5 °C	-	50 °C
Температура хранения	0 °C	-	60 °C
Вес	-	0,65 кг	-

Image 10. Technical specifications

And the last of the three grip options

Image 11. GRIPKIT-E1

Specifications

- 20 million work cycles guaranteed
- Uptime 24/7
- Automatic detection and monitoring of captured objects
- Support for up to 8 captures connected to one robot

A fully integrated solution for Universal Robots. GRIPKIT contains everything you need to realize the task of capturing and moving within a few minutes. It is fully compatible with all Universal Robots models and integrates seamlessly into the Polyscope software environment with the easy-to-use URCaps plug-in.

GRIPKIT is available in various sizes with grip forces from 7.5 to 550 Newtons and is compatible with all robots from Universal Robots, making it the ideal solution for a wide range of applications.

Software was used to work as collaborative robots.

- URsim
- RoboDK
- Programming environment – Python

The software RoboDK is such a description:

Processing robots

Use your robot arm like a 5-axis milling machine (CNC) or a 3D printer. You can simulate and convert NC programs (G-code or APT-CLS files) in the program of the robot itself. RoboDK automatically optimizes the robot path, avoiding features, axis restrictions and collisions.

Offline programming software

Modeling and autonomous programming of industrial robots has never been easier. Create your own virtual environment to simulate your application in minutes.

Easily create robotic programs offline for any robot controller. You no longer need to learn vendor specific programming.

Also, robbik has a built-in online library or manually loaded with many different manipulators, robots that you will find on the market, there are also many objects with which these robots work, for example, a grab or drill, or even a welding machine.

One of the conveniences of this program is that the programming of collaborative robots allows you to download program code written in the python language and edit in the program itself each movement in each axis individually for any task.

It can also be noted that robots can be controlled not only by a software algorithm, but also use a real-time control display (shown in the image 12).

Image 12. Control display

Display features

- Real-time robot control
- Emergency stop
- Monitoring the work of each axis and their degrees of rotation
- Robot calibration

Also, one of the programs for work is yursim software, it allows you to start work in a virtual mode, it is convenient when your robots are busy with work and stopping them can cause the process to stop, therefore testing certain modes of work in virtual mode is a good solution.

Principle of operation

The initial position of the manipulator is a capture over the conveyor in anticipation of a defective bottle (image 12).

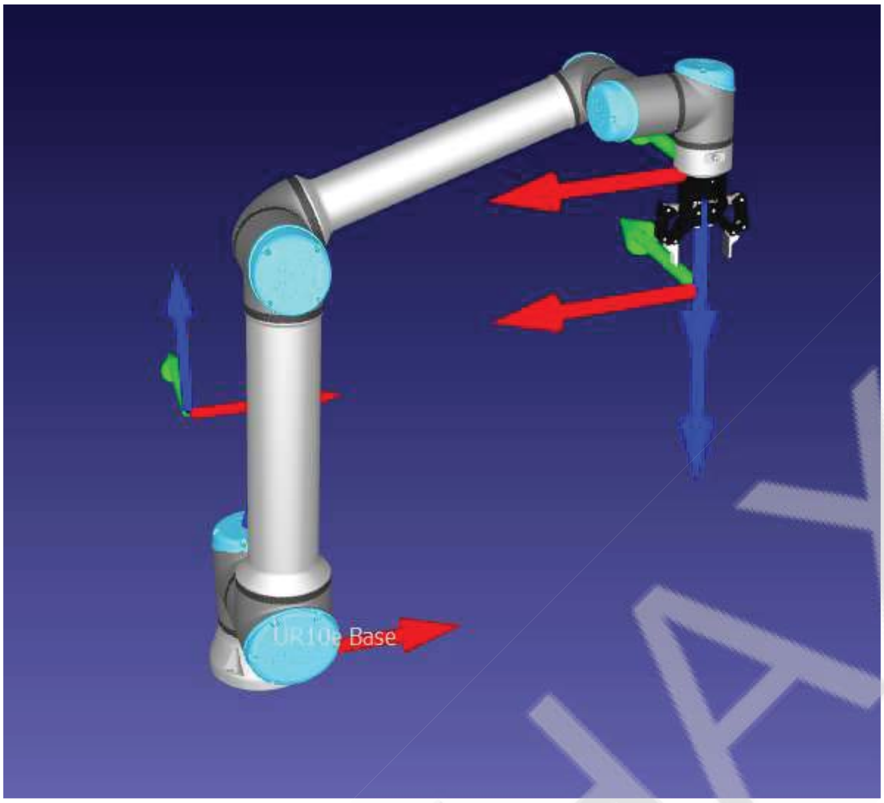

Image 13. Initial position

When a defective bottle is detected, according to the algorithm, the conveyor stops for a short period of time so that the dispenser fills and clogs the bottle, at the same time the marriage is monitored and the moment the conveyor pauses again, the manipulator will lower and capture the defect. (Shown in image 14)

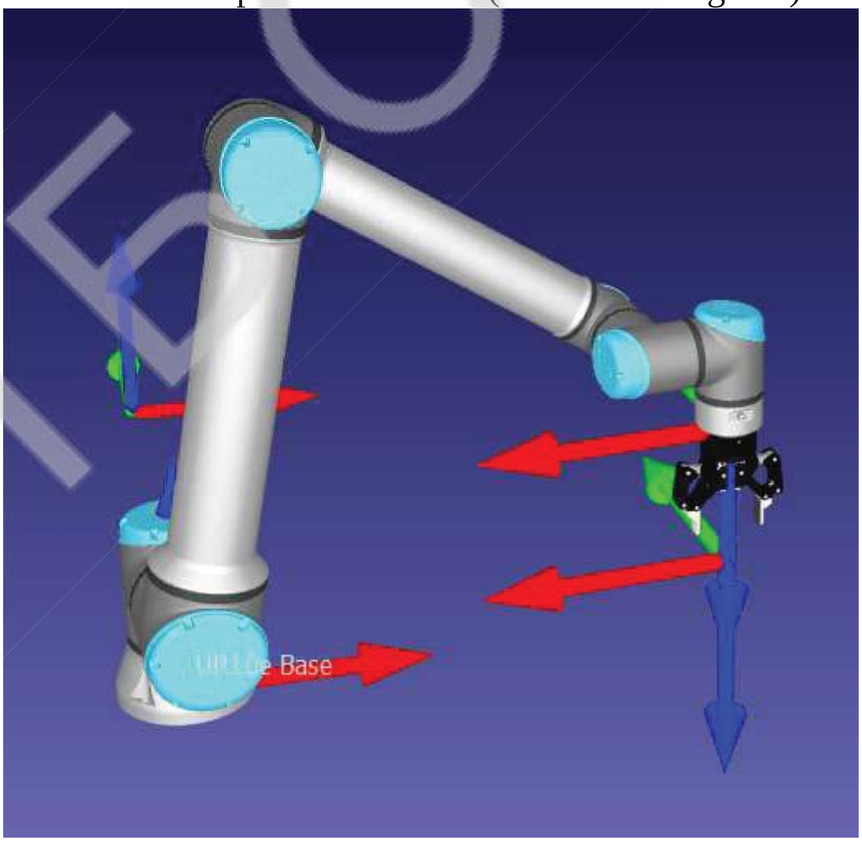

Image 14. Defective Bottle Capture

Then the bottle is lifted and moved to a box. (It is shown in figures 15 - 17)

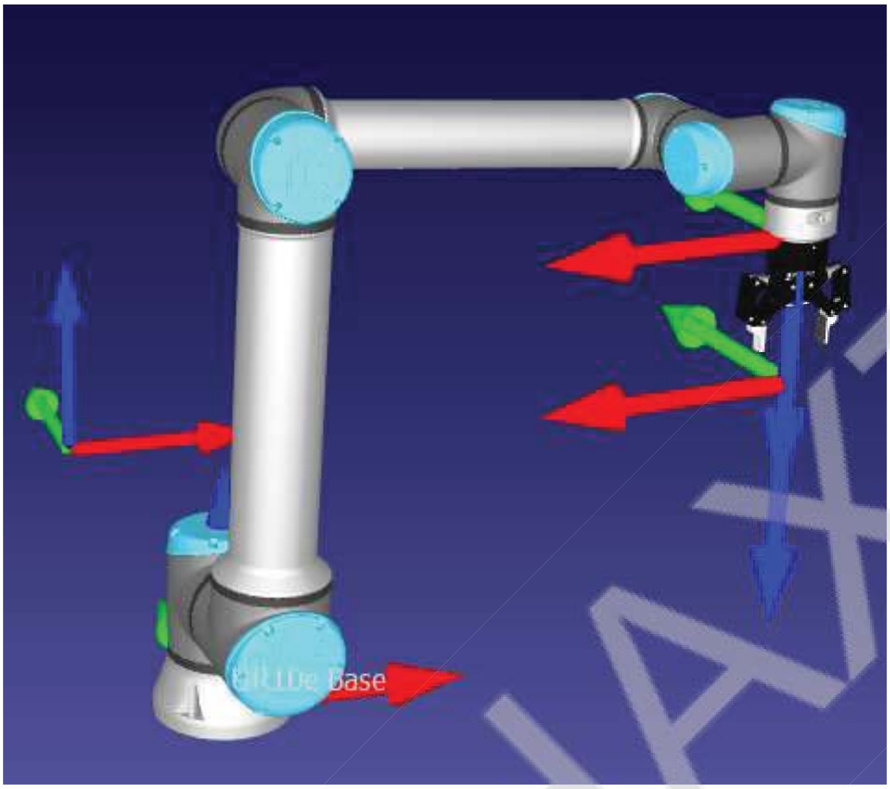

Image 15. Raising a defective bottle

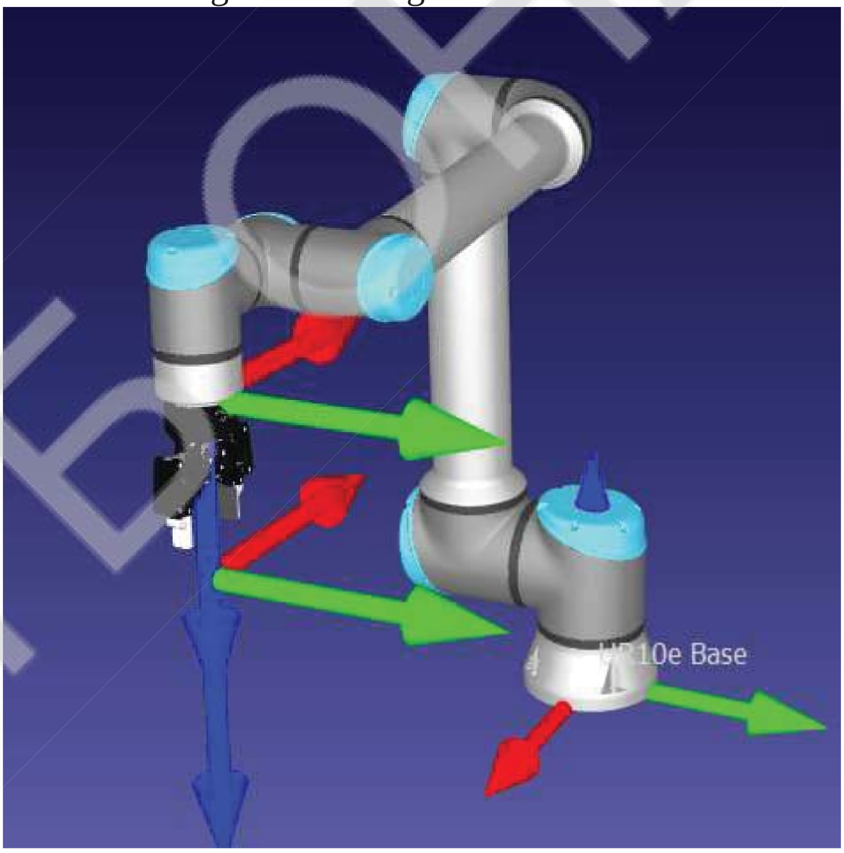

Image 16. Moving from a conveyor to a conditional box

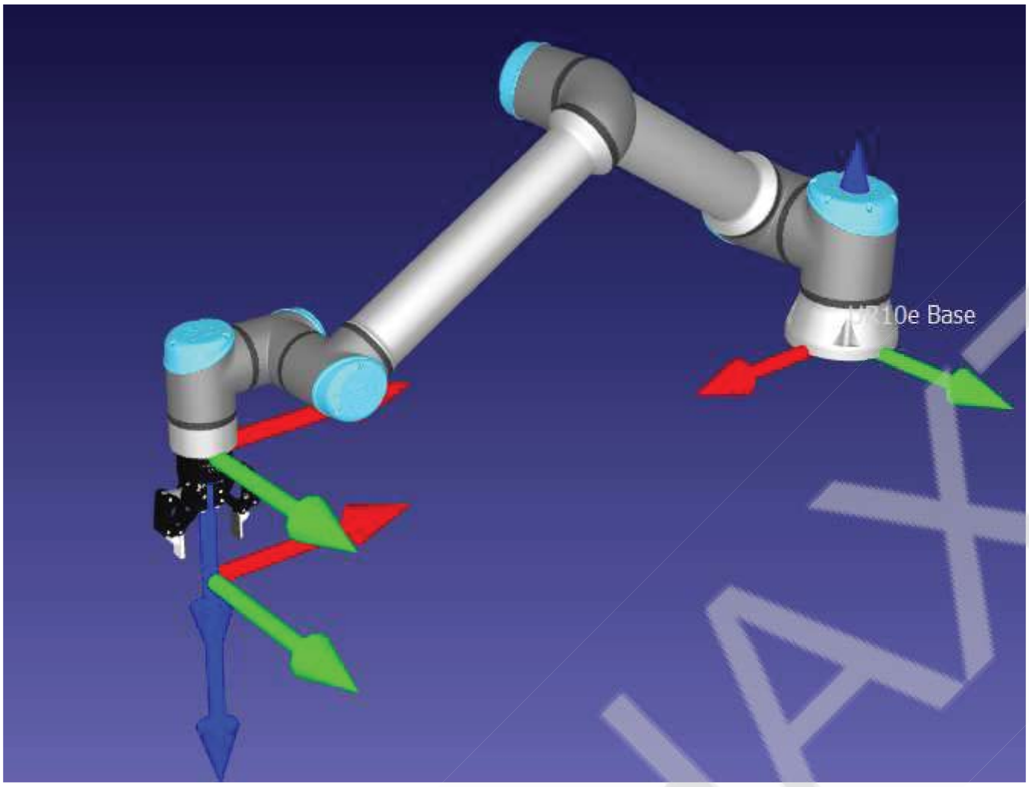

Image 17. Placement of defective products

Conclusions

The paper considers the task of production safety in the wine industry, namely, the safe contact of people with collaborative robots in the packaging section of the wine champagne technological process.

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