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ROBOTIZATION OF THE TECHNOLOGICAL PROCESS IN SELF-SERVICE SALAD BAR

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In Covid-19 pandemic many restaurants began to hire robotic waiters to minimize contact with customers. Since the announcement of the coronavirus pandemic, the market for so-called service robots has grown by 400%. They are currently used where there is a risk of human infection. That is why the problem of robots application needs to be studied to streamline a restaurant business. The use of artificial intelligence systems customer-to-customer and item-to-item will ensure the quality of food delivery sites, which will analyze the guest's order and identify the patterns of his preferences. Chat-bot automatically will propose a customer to choose a set or extra additions to an order that will increase the average check, or check a similar restaurant. This will increase the average bill and help new restaurants enter the market. The result has been an innovative scheme of robotization of the technological process for self-service salad bar. It consists of three steps: customer service by touchscreen booster, preparation and control of primary food and automatic preparation of salads. The implementation of the developed system can make the service more safety and faster; reduce the processing area, which will increase the service area thereby the revenue of the salad bar. The futher research should be devoted to the economic benefit of the implementation of the scheme and to the development of innovations in artificial intelligence which can help to deal with accounting processes, ordering products, marketing and social networks.

Keywords: artificial intelligence, culinary products, equipment, production, robot, technology.

РОЗРОБЛЕННЯ СХЕМИ РОБОТИЗАЦІЇ ТЕХНОЛОГІЧНОГО ПРОЦЕСУ САЛАТ-БАРУ

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Протягом минулих років виникла потреба в дослідженні застосування штучного інтелекту для функціонування закладів ресторанного господарства, оскільки в Україні та в більшості країн світу відсутній подібний досвід. Використання систем штучного інтелекту customer-to-customer та item-to-item забезпечить якісне функціонування сайтів доставки їжі, що дасть змогу проаналізувати замовлення гостя, виявити закономірність його вподобань і автоматично запропонувати йому певний сет, страву та вдалі доповнення до замовлення, що збільшить середній чек, чи

обрати новий заклад, що допоможе входженню нових закладів на ринок ресторанних послуг. Мета – здійснити теоретичний аналіз, систематизацію та узагальнення наукових досліджень і розробок щодо існуючих роботизованих технологій, розробити схему роботизації технологічного процесу на прикладі салат-бару. У ході дослідження застосовано методи логічного узагальнення для розроблення схеми роботизації технологічного процесу, що проводилося за допомогою комп'ютерної програми ArchiCaD. Проблему впровадження і використання штучного інтелекту вивчають учені в різних галузях науки. Розглядаючи їхні наукові праці, можна зауважити, що штучний інтелект уже активно використовується для виготовлення кулінарної продукції в закордонних закладах ресторанного господарства. Відомі приклади застосування роботів-бариста, роботів-піцайол, роботів-салатмейкерів, роботів-бургермейкерів тощо. У нашому дослідженні розроблено схему роботизації технологічного процесу салат-бару, що складається з трьох етапів. Першим етапом є обслуговування відвідувачів у торговельній зоні, де передбачено вибір замовлення, розрахунок через термінал, наступне автоматичне отримання кулінарної продукції й напоїв та споживання замовлення. Другим етапом є підготовлення напівфабрикатів у заготівельній зоні. Цим процесом керує кухар-оператор, який контролює потрібну кількість напівфабрикатів, проводить очищення та нарізання овочів, фруктів, м'ясних і рибних продуктів за допомогою машин для очищення та нарізання кулінарної продукції. Програмою передбачено аналіз залишку та необхідної кількості напівфабрикатів і вибір компонентів для приготування салатів штучним інтелектом. Третім етапом є автоматичне приготування салату в доготівельній виробничій зоні. Штучний інтелект, що розміщується в системі, аналізує замовлення гостя і активує контейнери з потрібними інгредієнтами, перемішує їх та вивантажує в посуд, який накривається пластиковою кришкою, а штампувальний елемент робота залишає номер замовлення на кришці. У запропонованій схемі передбачено дотримання санітарно-гігієнічних норм, що висуваються до закладів цього типу. У розробленій системі виробничої діяльності необхідна кількість працівників становить п'ять осіб: прибиральник у торговельній зоні, мийник посуду, пакувальник тацьь, кухар-оператор доготівельної зони та системний адміністратор штучного інтелекту. Розроблено схему роботизації технологічного процесу салат-бару, яка складається з трьох етапів: обслуговування відвідувачів, підготовлення напівфабрикатів, автоматичного приготування продукції. Після чого відбувається отримання кулінарної продукції й напоїв та споживання замовлення. Упровадження розробленої системи приведе до відсутності контакту між персоналом і гостями, пришвидшення процесу обслуговування гостей, зменшення площі виробничих приміщень та, відповідно, збільшення товарообігу закладу ресторанного господарства. Перспективами подальших досліджень заданої проблеми є вивчення економічних показників від упровадження розробленої схеми та розроблення інноваційних технологій штучного інтелекту, які б дозволили автоматизувати облік операцій закладу, замовлення необхідної продукції та

сировини, маркетингову діяльність закладу та навіть ведення соціальних мереж закладу штучним інтелектом.

Ключові слова: виробництво, кулінарна продукція, робот, технологія, устаткування, штучний інтелект.

Statement of the problem.

Target setting. The outbreak of coronavirus has forced humanity to adapt to new rules of conduct that prevent active social contact between people. To ensure social distancing in restaurants, the process of robotization of such institutions is relevant. This will ensure the absence of staff contact with guests and at the same time speed up the customer service and production of culinary products.

The facts of the use of artificial intelligence in human activities are already known. Sydorchuk emphasizes that the development of technology, total informatization and computerization transform the social services, economy and culture of modern society [10]. According to her, the development of neurotechnology, genetic engineering, nanotechnology, biotechnology and the widespread use of the Internet affect not only society but it also changes people, transforming their natural endowment.

Most scientists focus on studying the nature of the human intelligence, but there is no consensus on its definition and understanding. Progressive artificial intelligence began its development with the invention of computers in the 1950s.

Robot waiters, robot pizzamaker and robot burgermakers are striking examples of the use of artificial intelligence in the restaurant business. The use of such artificial intelligence systems as customer-to-customer and item-to-item is relevant. This will ensure the quality of food delivery sites, which will: analyze the guest's order and identify the patterns of his preferences and, thus, automatically propose the guest to choose a set and successful additions to the order, which will increase the average check; show a restaurants that fit guest's preferences, which will help new establishments enter the restaurant services market.

The state of study of the problem. Analyzing the concept of artificial intelligence, we can conclude that there are many definitions of the meaning "intelligence»є". Thus, Oliynyk argues that intelligence is the ability to solve problems in a creative way [7]. Koizumi suggests that intelligence is the ability to act appropriately and think rationally [3]. According to Samuel, intelligence is an innate quality, in contrast to the abilities acquired during training [8].

McAfee and Brynjolfsson emphasize that the emergence and development of artificial intelligence is inevitable [1]. There are many interactive and intelligent systems around us, such as personal assistant that

uses natural speech processing to make recommendations or answer questions. Even today, driving a car is possible without a human action; the car can move independently on the streets, stop at traffic lights or park.

The idea of artificial intelligence is mentioned in the article of the famous English scientist Alan Turing "Computing machinery and intelligence", which was published in 1950 [12]. The main question that was mentioned at the time in the article: can computers think like humans? According to the famous American futurist and inventor Hamilton, the fusion between computers and humans is so fast and deep that it is a turning point in the history.

Brynjolfsson and McAfee in their book "Second Era of Cars" classifies artificial intelligence as: 1) systems that think manlike (cognitive architecture and neural networks); 2) a system that acts manlike (pass the Turing test); 3) a system that thinks rationally (logical algorithms); 4) a system that acts rationally (an intelligent software agent, robots that achieve goals through planning, reflection, learning and communication) [1].

Machine learning researcher Smith attributes classifies artificial intelligence by four types based on the methods they use: "symbolists", "connectionists", "evolutionists" and "Bayesians" [9].

Considering the papers of researchers, we can conclude that there is no common definition of artificial intelligence, because it is a very young field of research. But to our mind artificial intelligence is a characteristic that is used to determine the intellectual capabilities of computers in their decision-making process.

A significant number of scientific papers in the United States are devoted to the study of artificial intelligence, which confirms a deep understanding of the need for its use. It is well known that the US government annually reports about achievements in implementations of new information technologies, including artificial intelligence, in order to improve and facilitate the work of people. From the content of these reports, it can be concluded that the United States is one of the leading countries, which care about the global development of artificial intelligence at the state level.

In October 2016 the US Government presented a document "Preparing for the Future of the Artificial Intelligence," which states that artificial intelligence technology opens up new demand and new opportunities for progress in critical areas such as health, education, energy and the environment. This document consists of several definitions of "artificial intelligence". Thus McAfee and Brynjolfsson define it as a computerized system that thinks as it programmed. Others define the

concept of "artificial intelligence" as a system that can rationally solve a set of problems and learns to achieve goals regardless of real circumstances [1].

Outstanding Issues. Currently, there are two approaches to classify artificial intelligence: algorithmic coding and machine learning [13]. In algorithmic coding all the steps are prescribed manually, while machine learning lets the created algorithm to learn on a certain amount of data and allocates its own rules independently. Algorithmic coding, which has its positive aspects, such as predictability and the ability to act within the program, is failed as noted by Lubko and Sharov [4]. At the same time, artificial intelligence based on machine learning allows to act differently in similar situations, taking into account the previous results. The above confirms that the problem of artificial intelligence has not been fully studied [11]. It should be declined that the use of robotic technologies in restaurant activities is still an unexplored task.

Materials and Methods. Goal of research is to perform theoretical analysis, systematization and generalization of scientific research about robotization in restaurant business; create a robotization scheme of the technological process for salad bar.

The framework of the study is the theoretical and methodological aspects of problem setting and analysis of research results by new theoretical developments and modern computer modeling.

Research design. The methods of logical generalization were applied In the research. The Conveyor-robot assembly of Salad-Bar was developed by using ArchiCaD-supported modeling.

The study object is the food processing in the salad-bar.

Results and Discussions. Even today people are using technological innovations that point to the approaching era of artificial intelligence: unmanned robotic vehicles; voice services; smart houses, etc. One of the leaders in the study of the practical application of artificial intelligence was the American company Apple, which created a prototype of artificial intelligence – a Smartphone. Siri's voice assistant appeared in the iPhone 4S in the 2011, which revolutionized the IT industry. After a while, Google introduced its smart service Google Now.

Unlike Siri, the Google product strives to be useful not only when the user needs it, but also when he doesn't even think about it. Google Now works automatically, like the autonomic nervous system. This system tracks the movements and actions of the user and learns his habits. By calculating the time when the user regularly returns home from work, Google Now checks the traffic service in advance and shows the optimal way by car of bus. Microsoft has similar systems: a virtual assistant with a female voice and the name of Cortana, designed for dialogues with user.

Artificial intelligence "smart house" is a concept that scientists have been researching for decades. Nowadays, several large companies are making significant efforts to bring concrete solutions for artificial intelligence systems, including Apple, which introduced an unified wireless protocol for managing home appliances by the iPhone.

It is necessary to mention about innovations of the Chinese company Xiaomi, which offered to equip their air fresheners with a Bluetooth module. This reminds users, when it's a time to change the filter. Xiaomi later introduced four "smart house" modules, which include a webcam that can control a TV, air conditioner, music center, smart outlet, which allows you to remotely turn off any household appliance. All these gadgets can be controlled by the user through a smartphone and voice commands.

Unmanned robotic vehicles are another proof that the era of artificial intelligence has begun. Business car owners already use on-board computer features such as traceability, adaptive cruise control and collision warning system that can release gas and brake on its own. Volvo, Audi, Volkswagen, Range Rover, Acura and other companies equip their cars with such systems.

The European Commission presented in April 2018 a strategy on artificial intelligence, which sets the main goals as strengthening the technological and industrial capabilities of the EU with its application in various sectors of the economy, providing "appropriate ethical and legal framework" and preparing for socio-economic change.

Ukrainian developers are active leaders in the idea of a completely different approach to the development of artificial intelligence. According to them, you first need to learn to feel the car, and only then learning it to think logically. And this can only be achieved by giving the car the opportunity to communicate with people so that it can get to know mankind better. Ukrainian startup Digital Life Lab is working on the KARA project development. This is a model of empathic artificial intelligence. KARA is at the stage of preliminary testing and according to its developers it will possible to recognize the mood, emotions and feelings of the guest.

In June 2020, the famous Ukrainian restaurateur Dmytro Borysov announced on his Facebook page the opening of the gastronomic platform Gastrofamily Food Market. There a bot assistant helps guests to choose a restaurant and dishes from the menu according to their preferences.

It is worth to give a few examples of use artificial intelligence in restaurant business to demonstrate its level of robotization. Thus Chowbotics plans to place robot station Sally in restaurants, cafeterias, hotels, airports and healthcare centers. It is based on stations in which the working devices contain about 20 plastic containers with chopped

vegetables and when guests is choosing an order, the robot combines it into salads. Such station is equipped with a touchscreen for meal order and a payment terminal. Artificial intelligence informs about nutritional and energy value of the salads; helps guests to choose the ingredients and portion size according to their age, sex, allergies and preferences. An option to improve this system is to learn artificial intelligence to determine the balance of semi-finished products, the required amount of food raw; plan the necessary food budget based on sales analysis.

Kitchen robotics developer Miso Robotics has released the burger maker robot Flippy. This artificial intelligence is able to separate between a piece of chicken and a bun or ready-made burger and semi-finished product by its shape, color and temperature.

Company suggests calling Flippy as "cobot", which means cooperative robot. If the machine detects the presence of a human in the work area, the machine will stop immediately to prevent collisions with a man and avoid injury.

The American supermarket chain Whole Foods is developing a robotic barista Briggio. That artificial intelligence will be able to receive orders from the Internet through a personal account on the developer's website. So you can pay and choose your order online while you are on the way to the supermarket [6].

The Momentum Machines project has developed the burger machine. It is equipped with 350 sensors and 20 computers and can make 400 burgers per hour. This robot will speed up service and increase the income of the owner. So for an hour of work at the average price of a burger at 6 dollars it is possible to receive the income in 2400 dollars that is 3 times more than the average income of fast food establishment in the USA.

In San Francisco robot barista moves around the airport and offers guests a choice of coffee beverages and the ability to pay by card. So now guests do not have to look for a coffee shop, now coffee is looking for those who want it.

Robots have replaced chefs at restaurant Spyce in Boston. It was created by four graduates of the Massachusetts Institute of Technology and approved by the restaurant's prestigious chef Daniel Buluda. Spyce is considered to be the first restaurant in the world with robotic cuisine, where complex dinners are prepared.

Robot-bartenders at the Bionic Bar on the Royal Carribean liner not only speed up the preparation of beverages, but also are part of show [6]. There is panel with more than a hundred bottles of alcoholic beverages above the robots. Guest can choose a beverage from 30 options by the menu

on the tablet or by the mobile application downloaded in smartphone. After that guests can watch how robots mix and shake the necessary ingredients.

Robots are used to make pizza in the American restaurant Zume Pizza. One robot adds sauce on the dough pieces, the next robot puts the ingredients, then other robot transfers the pizza to the oven, controls time of cooking and serves it. This station is located in a portable van, so the pizza can be prepared on the way to the customer, which reduces delivery time.

The Chinese restaurant Dalu Robot in Jinan uses 12 robots. The robots move around the guests on small bicycles and deliver meat and vegetables, which visitors dip in boiling broth. Each robot is equipped with a motion sensor that allows it to to stop at the right table. In addition, they act as hostesses, as well as entertain guests by singing and dancing.

The Japanese restaurant FuA-Men automated the preparation of noodles using the robot "Fully Automated Ramen". It needs one minute and 40 seconds to cook the noodles that are 80 servings per shift. The quality of meal does not differ from traditional ones.

At the Russian company Promobot, the robot helps people with navigation, answers questions, distributes promotional materials and memorizes everyone with whom he had to communicate.

The authors developed a scheme of conveyor-robot assembly of salad-bar which is shown in the figure based on a preliminary analysis of the artificial intelligence usage in restaurants (Fig. 1).

This scheme consists of three stages. The first stage is a customer service. First, guests make their own order at the touchscreen terminal: in the dialog box they choose a salad (this can be a suggested recipe or created by the visitor from the suggested ingredients) and beverages. After confirming the order, guest pays for it through the payment terminal and receives a check with the order number. The next step for the visitor is to receive the order in the serving area through the appropriate window. The guest identifies his own order by the check number, which is stamped on the cover of the salad. The next step of the visitor is to receive the ordered beverage in the appropriate machine by entering the check number on the touchscreen. Further actions meet the requirements of self-service in salad-bars.

The second stage is the preparation and control of primary food. This process is managed by a chef-operator, who prepares the required number of primary food; washes and cuts vegetables, fruits, meat and fish products by special machines. Then primary food is sorting by a robot. It recognizes products by size, shape and color, and transports it to the appropriate container.

Room list	
№	Room identification
1	**Service Area:**
1a	Guest's order zone
16	Food receiving area
2	**Processing area:**
2a	Primary food processing
26	Final Processing
3	Tableware wash
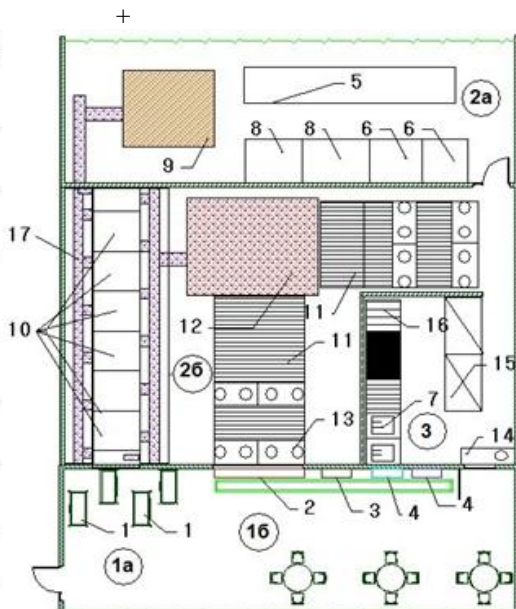
Equipment list			
№	Equipment identification	№	Equipment identification
1	Touchscreen terminal	9	Robot Food Distributor
		10	Food Doser
2	Serving counter	11	Conveyor
3	Hot beverages machine	12	Robot Salad-maker
4	Cold beverages machine	13	Таця із замовленням
5	Worktable	14	Disposal Table
6	Vegetable peeling machine	15	Tableware cabinet
7	Wash bath	16	Dishwasher
8	Vegetable cutting machine	17	Food transfer canal

Fig. 1. Conveyor-robot assembly of Salad-Bar (Source: Own Development)

The third stage is the automatic preparation of salads. Artificial intelligence analyzes the guest's order and activates the containers with the necessary ingredients. The proportional machine measures out the required amount of ingredients in a special box, which stops under each container and then transfers products to the saladmaker robot via the food canal. When salad is prepared and dressed, it transfers to the plate, covered with a plastic cover and the stamping element leaves mark of the order number on a cover. After that the tray with the order is transported on the conveyor to the serving room, where it is picked up by the visitor.

During the operation of the proposed system the amount of primary food in the container decreases over time. Therefore, our proposal is to teach artificial intelligence to analyze the hourly number of visitors and their orders for previous days and weeks and to calculate the limit of the primary food in the containers. Thus, when the number of primary food becomes less than that amount, the operator will be signaled that it is urgent to prepare a certain product and load it into the container.

With the developed robotization system the required number of employees will decreased to 4 people: a steward in the service area, a dishwasher, a cook-operator and a system administrator of artificial intelligence.

The implementation of the developed sheme will allow to achieve a high quality product. The use of robots makes it easier to meet the requirements for hygiene, cleanliness, temperature, humidity and other standards. Reducing the contact between visitors and restaurant employees ensures a high degree of sanitary safety.

Restaurateurs who are constantly working on the optimization of the technological process and service in their restaurants are interested in the use of robots, as this innovation in the restaurant business helps to improve production and service and arises interest of visitors.

Soon the use of artificial intelligence in restaurants will be an ordinary part of service. That is why restaurateurs have the opportunity to be among the first in Ukraine to implement this innovation in the use of artificial intelligence and use the robots in the technological process of restaurants.

Conclusion. Developed an innovative scheme of robotization of the technological process for self-service salad bar. It consists of three steps: customer service by touchscreen booster, preparation and control of primary food and automatic preparation of salads.

The implementation of the developed system will ensure the absence of staff contact with guests and at the same time speed up the customer service and production of culinary products. Such innovation can reduce the processing area, which will increase the customer area and revenue of the salad bar.

The futher research should be devoted to the economic benefit of the implementation of the scheme and to the development of innovations in artificial intelligence which can help to deal with accounting processes, ordering products, marketing and social networks.

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THE PHYSIOLOGICAL FUNCTION AND APPLICATION OF CEREAL B-GLUCAN IN THE FERMENTED DAIRY PRODUCTS

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β-glucan is an important dietary fiber, it has many excellent physiological functions,and alsois one of the important raw materials for preventing many chronic diseases. Cereal β-glucan is a functional ingredient with easily obtain, and has a high market share. Firstly, the structural characteristics, sources and physiological functions of β-glucan were introduced in this paper; following, the physical and chemical properties of β-glucan were introduced; finally, the current situation of cereal β-glucan as a functional food ingredient in fermented dairy products was discussed. Overall, cereal β-glucan has a good affect in the fermented dairy products.

Keywords: *cereal, β-glucan, physiological function, application, fermented dairy products.*

ФІЗІОЛОГІЧНА ФУНКЦІЯ ТА ЗАСТОСУВАННЯ ЗЕРНОВИХ β-ГЛЮКАНУ У ФЕРМЕНТОВАНИХ МОЛОЧНИХ ПРОДУКТАХ: ОГЛЯД

Qu Xiaoqing, Ю. Назаренко, Лі Бо

β-глюкан – це полісахарид із довгим молекулярним ланцюгом, ланки якого представлені глюкозою. Він відноситься до біологічно активних речовин, сприятливо впливає на всі внутрішні органи і системи людини.