



The use of Robotics in the Kitchens of the Future: The example of 'Moley Robotics'

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Abstract

As in all areas of the tourism sector, it is considered a necessity rather than a choice to adapt to technological developments in kitchens that provide food and beverage services. It is unthinkable that the kitchens, which are foreseen to take place in the future, will be independent of robotic tools. From this point of view, this research also addresses the current structure of robotic use in kitchen technology and evaluates the technological tools that are planned to be used in the future. In this context, attention is drawn to the situation of the sector based on the products and applications of 'Moley Robotics', one of the world's leading companies in robotic use. In line with the results obtained from the research, it is seen that the use of robotics in all areas of the kitchen has started to become widespread and it is predicted that this situation will increasingly continue in the coming years. When the social media (Instagram) interactions of the Moley Robotics organization are observed, it is understood how important the use of robotics is in kitchen applications.

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INTRODUCTION

Every organization that wants to protect and strengthen its current existence by acquiring a sustainable environment makes its investments in this direction for the future. In this context, they are based on technological infrastructure, which will be one of the main points in the construction of the future. There are similar situations for food and beverage businesses, which are in the service sector and where the competitive environment is most intense. These businesses, which are aware of the interest in technology, tend to use robotic tools more to attract the attention of consumers. In this direction, robotic tools supported by smart applications in gastronomy-based kitchens, which are the common point of nutrition, taste, and socialization needs, are frequently encountered recently. (Zoran, 2021, p.36).

Technological developments have been seen in all sectors in recent years, as well as in the field of gastronomy. Over time, electronic tools began to take the place of work outputs obtained by human power. In addition, it is also stated that the use of robotic tools in the kitchen has increased with the introduction of autonomous systems, smart applications, and artificial intelligence programs (Junge et al., 2020). Especially since it is an industry where electronic tools are used very often, gastronomy can gain a habit of robotic use more easily (Shiwa et al., 2009, p.142). However, due to the high costs of robotic vehicles, it is not possible to talk about these vehicles in the industrial kitchens of many countries outside the developed countries. In addition, individuals with the ability to use robotic tools should be employed (Breazeal, 2004; Zhan & Shi, 2012).

Although it is noticed that the use of robotic vehicles has spread to all areas of the tourism sector such as accommodation, travel, entertainment, and food and beverage, it is seen that there are very few encouraging steps in kitchen areas (Indiveri & Parlangei, 2006; Kim & Jung, 2011; Sparrow & Howard, 2017). At this point, with this research to be done, Moley Robotics, which has initiatives to encourage the use of robotics in the kitchen and is one of the pioneers in the world, will be examined. In addition, it is tried to reveal in which areas it is concentrated by including robotic usage tools in the kitchen. The research aims to contribute to the issues to be done in the related field by emphasizing the robotic tools used in the kitchen, in particular Moley Robotics.

Literature Review

Robotization and Kitchen Technology Relationship

Robotic applications, one of the most important outputs brought by technology, are defined in the most general form by IFR (International Federation of Robotics), although it is tried to be expressed in different ways. Service robots used in kitchen technology are described as "a robot that performs useful tasks for people or equipment outside of industrial automation applications" (IFR, 2021).

Technology and culinary arts are expected to mark the future. It is stated that the convergence of these two variables with each other in terms of hygiene (cleaning, epidemic diseases, etc.) and menu standards (consistency, amount, visual plating, etc.) will go further (Kirkman et al., 2021, p.721). Considering that consumer demands and trends have been adapting to technology development in the recent period, the importance of the relationship between kitchen applications and technology emerges. The sustainability of organizations and institutions that continue traditional cooking methods, preparation and service methods by not using the technology infrastructure in the

kitchen industry is in danger. Because technology is now have been accepted as the future itself, rather than what is expected in the future.

Kitchen establishments that offer robotic technology offer a new experience, interesting applications and services with a wide range of comfort for their consumers (Alexis, 2017, p.211). By interacting with these technological tools, services are produced for communication, meeting their psychological needs and wishes (Özgürel, 2021, p.1852). With the use of robot technology in the kitchens, plating and cooking techniques are planned to be done by the standards and correctly (İbiş, 2019, p.411). However, one of the most important problems of the use of robotics in the kitchen will be that the creativity factor will gradually decrease because it does not contain human emotions (Cha et al., 2015, p.319). In addition, negative situations may arise against situations such as lack of energy, social interaction and taking urgent measures against risks. The effect of technological developments on the traditional kitchen approach and the roboticization process will have a two-way effect (Chen et al., 2020).

There are many technological devices, especially electronic products, in kitchen areas (Rodgers, 2009, p.72). Kitchens, which serve in large-scale enterprises such as hotels and restaurants, also contain technological tools in industrial terms (Mercan et al., 2020). In addition to all these, artificial intelligence, contactless ordering, mobile communication and product preparation possibilities with the highest hygiene sensitivity combine robotic technology with kitchen applications (Beetz et al., 2007). The kitchens of the future, which want to meet the demands of those who want to receive technology-based service, focus on technological developments. From this point of view, it is thought that the relationship between kitchen and robotic technology will continue increasingly in the coming years (Georgoulas, et al., 2012; Blasco et al., 2014; Berezina et al., 2019; Richards et al., 2022).

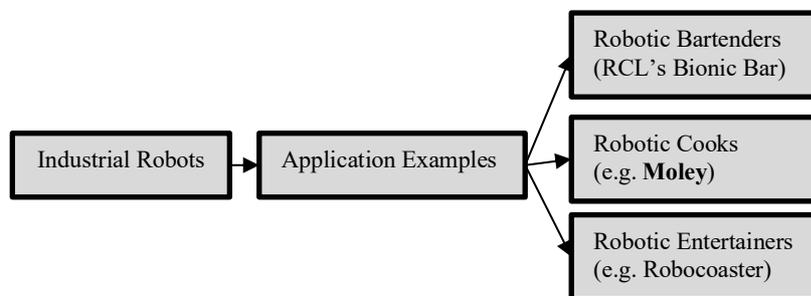


Figure 1. Robot Applications in Tourism

Source: Alexis, 2017, p.212

As can be seen in Figure 1, which summarizes the relationship between robotic use and kitchen technology in its most general form, 3 services stand out in the application areas of industry and robots: Robotic Bartenders, Robotic Entertainers and Robotic Cooks. The place of the use of robotic tools in kitchen technology in the service industries draws attention and is also the subject of scientific research. The reason for this can be said to be the increase in the use of robotics in the coming years instead of human power.

Robotic Usage Process

With roboticization, technology-based tools have started to replace human-oriented workforce and efforts. Robots are asked to create a chain learning algorithm and perform tasks with 3D pointer trajectories required for production and service. The robots learn about the objects and properties defined for them and associate the new coding with the

targeted training images. Robots, which perform the design, application and daily workflow in the preparation process of the product in the kitchen, work with autonomous systems with cognitive support (Pfau, 2019, p.87). It is estimated that the number of robotic vehicles that are planned to replace chefs in the kitchens of the future will play a greater role in the product preparation process. As a matter of fact, according to the IFR global robotics report, the total number of service robots sold in 2016 increased by 24% compared to 2015. The number of service robots in the field of gastronomy providing culinary services increased by 133% compared to the previous year in the same period (Garcia-Haro et al., 2021, p.3). This situation reveals that the interest in robotic vehicles is increasing day by day in terms of statistics.

Pioneer in The Use of Robotics: Moley Robotics

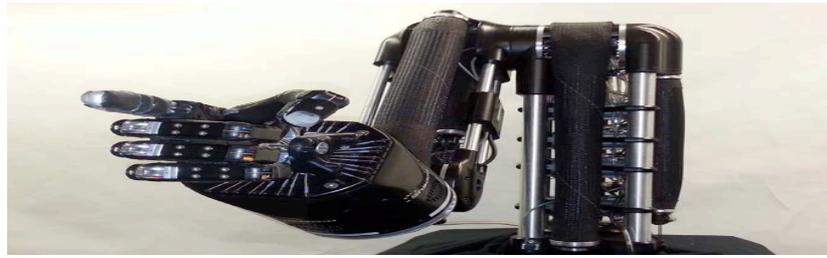
Robotization and automation systems are growing rapidly in the food industry, as well as in every industry (Kostyuchenko et al., 2019; Fusté-Forné & Ivanov, 2021). Contrary to traditional using more than one kitchen appliance and preparing many products (Noone & Coulter, 2012). One of the first examples of this is the world's first robotic kitchen technology robotic tools developed by Moley Robotics. Organizations such as Cockburn and Ormrod are attempting to increase the technological possibilities in the kitchen (Treusch, 2015, p.43). Previous studies on robotic kitchen tools often consisted of imitating chefs' talents, skills, and creative intelligence (Junge et al., 2020, p.762).

Customizable products with 3D printing, optimization of food parameters and measurable parameters of food to give the closest results to the standards are the main goals of robotic technology in the kitchen. Because people's limited control over the cooking process does not allow the product to be prepared uniformly and fulfill the most suitable taste, consistency and texture conditions. With the use of robotics in the kitchen, all requirements with control data entries, correct determination of parameters, process management, cooking degree and visual elements can be carried out more easily. It is thought that the use of robotics will become more common day by day due to the unlimited wishes and customizable demands of people. In this context, Moley Robotics, one of the leading companies, develops many robotic tools in the kitchen and offers them to people. Moley Robotics, which set out in 2015 intending to develop revolutionary robotic kitchen tools that offer an unlimited variety of dishes and gourmet quality, adopts advanced technology and unique design in the kitchen as its mission. Some of the robotic tools he put forward in this context are as follows (Moley, 2015);

Shadow Robot Hand

Shadow robot hand studies first began with the realization that its effectors were stabilized at the level of the three-fingered gripper. Later, with the advancement of research towards the development of a fully functional hand, the design of the robotic hand took on more biological characteristics of human muscles. In this direction, the shadow robot hand can perform the functions of the muscles and can perform many movements in a short time (Tuffield & Elias, 2003, p.58).

Imitating the hand limb, which is the most complex structure of the human body, Shadow consists of 20 motors, 24 joints and 26 microcontroller mechanisms. Shadow is used in countries such as the USA, China and Japan as the closest robotic kitchen tool to human hand sensitivity.



Picture 1. Shadow Robot Hand

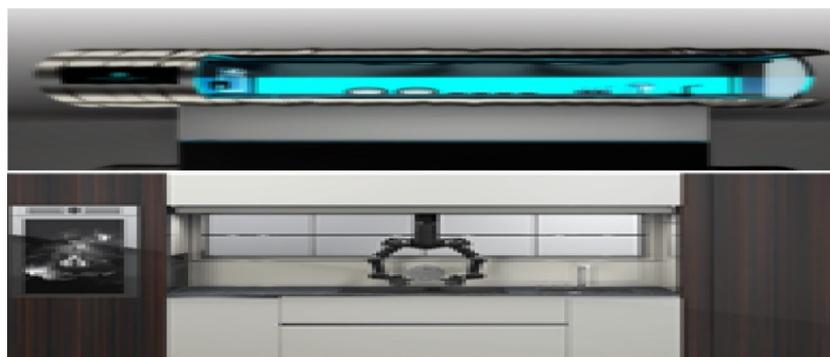
Source: (<https://moley.com/>)

Moley Robotic Kitchen

One of the most important steps in the development of the comfort zone of individuals is the emergence of symbiosis environments in which robots help people in the kitchens of ordinary houses. Robotic kitchens, one of the key components of robotic vehicles, are room-type robot systems in which various robot components such as sensors and actuators are distributed in the room and used to assist users by connecting over the network. Software is developed to control all components of the robotic kitchen system and is developed on the network to provide personalized assistance, adapted to the action of preparing food by predicting the next action of people. All actuator components come together in this robotic device for comparison of current sensor data with historical data in the database, sensing cooking processes and aiding preparation (Morishita et al., 2003).

Moley robotic kitchen has the following features;

- It is coordinated by a pair of robotic hands that can be controlled by automatic arms.
- It works in coordination with parts such as a steam oven, induction cooker, sink, mixer, and dishwasher.
- It prepares the products through the software platform.
- It can provide independent food preparation and a cooking environment.
- It contains all the necessary components for the product to be ready.
- Coding the physical movements, speed and time management of an expert chef exactly ensures that the product is cooked according to the recipe and similar results are obtained.



Picture 2. Robotic kitchen Prototype and Demo

Source: (<https://moley.com/>)

Mixing Robot

A trend toward mixer robots arose as a result of realizing that too much time is wasted in the kitchen mixing or integrating products. In this context, Robot Coupe, the first food processor with a blade at the base and fulfilling the mixing function, was developed in 1960 (Tekmen, 2007). This device is thought to be a source of inspiration for companies producing high-tech kitchen equipment such as Moley robotics and forms the basis of today's technology.

The Mixing Robot includes basic movements such as directing the product or an object, moving it on the table, pouring into the equipment, moving the spatula on the table, scraping and mixing. In this context, it uses both end-effector location and conformity control techniques. The robot performs its gripping functions by holding the mixing bowl in place. The end effector on the mixing bowl moves the other end effector with an attached spatula via the position control. Finally, the effector activates the Cartesian exciters, bringing the mixing arm into contact with the product. The main goal of the mixing robot is to achieve standard values by presenting solutions against the risk of time loss and excessive mixing (Bollini et al., 2013). At this point, it proves the utilitarian outputs of the technological development in the kitchen.

The mixing robot is an automatic intelligent unit that can independently prepare, flavor and serve a complex dish in a hygienic environment



Picture 3. Robotic kitchen Smart Mixer

Source: (<https://moley.com/>)

Moley App

Smartphone applications based on the use of QR codes are increasing day by day to manage raw material stocks and understand cooking times in kitchens. While helping the users of the applications to choose the storage location, especially the refrigerator and the kitchen, it generates reports on the products to be purchased and the necessary business actions. Applications also provide very important information about cost by facilitating kitchen management such as adding, deleting and controlling kitchen appliances list (Jarupunphol et al., 2018). Although it is frequently used in food and beverage businesses (Mirbagheri & Hejazinia, 2010; Freeman et al., 2014; Gao & Ahn, 2022), it is observed that mobile applications are limited in the kitchen area.

By using the Moley Robotics application, you can manage a menu programmed with more than 2,000 recipes. Robotic tools can do the same if you make a recipe while wearing application-specific gloves. With these robots, which will replace almost everything you use in the kitchen, you can order food from far places.



Picture 4. Moley App

Source: (<https://moley.com/>)

Moley Robotics, which designed the integrated robotic kitchen system, which is a first in the world, continues to bring much more to the kitchen industry than some of the examples mentioned above. The technological efforts of these and similar organizations will enable us to talk about more robotic tools in the kitchens of the future. On the other hand, these tools, which will interact with artificial intelligence and remote access, will offer great opportunities in facilitating human life.

Result and Discussion

Human life, which has gained a different dimension in line with technological developments, shows a tendency towards innovations and creativity day by day. Organizations that want to meet changing demands and personal wishes focus on the new product development process and want to use technology in the most efficient way to gain an advantage over their competitors (Petersen et al., 2003, p.285). Gastronomy and culinary arts, which are one of the areas where the most intense competition environment is experienced in the service sector, have difficulties in the transition process due to being too dependent on human power, although they are sensitive to technological developments. However, Moley Robotics, which emerged with the vision of meeting the necessary needs in nutrition and cooking without the need for humans, brings a different approach to kitchen technology. In particular, it is not only a robotics company that develops, creates and launches the first robotic kitchen based on a multifunctional cooking platform, but also inspires the kitchens of the future. In addition to the innovative examples it brings to kitchen technology, it also plays an important role in the widespread use of robotics. The relationship between the kitchen and technology was limited to electronic tools and ideas about robot chefs did not make complete sense. However, over time, it is estimated that more robotic use will be accepted with the new services that Moley and similar organizations will offer to kitchen technology. When the shares made by the related organization on the Instagram account, which is the social media account, are examined by the researcher, it is seen that there is a high level of positive reactions by followers. It is expected that the technological developments developed by organizations such as Metaverse and Microsoft in the virtual universe will also be seen in the kitchen areas. Because the feelings of nutrition and pleasure, which are the important parts of human pleasure, will go one step further and support the use of robotics thanks to technological steps.

To better understand and develop the chemical and biological basis of gastronomic products, the need for technological tools in many kitchen types, especially molecular cuisine, is increasing rapidly (Vega & Ubbink, 2008). Robotic vehicles, which are at the forefront of technological equipment, especially in terms of product quality standards and time cost, have started to be seen more and more in kitchen areas (Noone & Coulter, 2012). However, using basic technological kitchen tools (Ruiz et al., 2013), being too dependent on human power (McClung et al.,

2018), need for energy (Kumar et al., 2021), and not relying too much on technology (Capatti & Montanari, 2003) delays the advancement of robotic kitchens. At this point, it can be said that the moley robotics approach, which is considered within the scope of the research, not only contributes to the relationship between technology and the kitchen but also shows an exemplary character in encouraging other sector organizations. On the other hand, it is stated that robotic technology will attract more and more attention in individuals' eating and drinking behaviors and perceptions (Sato et al., 2004; Zhu & Chang, 2020). This suggests that in the future, a kitchen understanding devoid of robotic tools will face serious problems in terms of maintaining its current existence. Because, requests such as food orders, smart menu choices, hygiene-oriented contactless delivery and the standard of the gastronomic product through smart devices give an idea about the behavioral trend towards the kitchen for the consumers of the future (Pulos & Leng, 2010; Sun et al., 2015; Saeed et al., 2016; Pillai et al., 2021). Trends like these show that robotic vehicles can take more place in the kitchens of the future and the need for humans will decrease.

Conclusions

Looking at the overall research and the relevant literature, it is seen that the use of robotics in all areas of the kitchen will be on the rise in the future. However, it is not predicted exactly what will be the positive and negative situations technological developments will bring to the human workforce. For this reason, it is thought that the use of robotics brought by technology should be investigated in-depth based on benefits and harm. In other words, it is a good analysis of the effect of technological changes that will occur in the kitchen on the quality of gastronomic products and their comparison with human creativity. At this point, it is assumed that different information will be obtained with further studies by scientists on the subject.

Ethical Statement

During the writing and publication of this research, the rules of Research and Publication Ethics were followed and no falsification was made in the data obtained for the research. Ethics committee approval is not required for the study.

Contribution Rate Statement

From the drafting of the research article to the final version, the author contributed to all processes with all his knowledge and equipment and evaluated and approved the final version.

Conflict Statement

This study did not lead to any individual or institutional/organizational conflict of interest.

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