

INTERNET OF THINGS (IOT) IN THE KITCHEN UNDER THE CONCEPT OF GASTRONOMY 4.0

Abstract: The Internet of Things is one of the concepts that has become increasingly popular in recent days. When viewed from a conceptual perspective, it can be said that this concept, which is expected to be usable in many sectors, also has various reflections in the gastronomy sector. Especially in these times when we feel the use of the internet in almost every area of our lives, what can be done with the help of the internet attracts the attention of researchers. Thanks to this interest, the fact that the internet and different devices bring a new perspective to the gastronomy sector is revealed.

In this study, it is aimed to make a literature review on how and for what purposes the Internet of Things will be used in kitchens within the scope of Gastronomy 4.0 and what kind of benefits it will provide. The gastronomy sector is one of the important marketing tools for countries, societies and cultures. At this point, many meals are prepared in industrial kitchens every day in accordance with social and individual health conditions.

Thanks to the Internet of Things technology, being able to be informed about what is happening in the kitchen anywhere and at any time can enable the realization of the concept of sustainability, which is one of the most important problems of our day, by providing good menu planning and waste management, especially hygiene and food safety. With this concept, industrial kitchens can have the potential to reach a much better point within the framework of carbon footprint and water footprint.

In summary; It is seen that the concept of Gastronomy 4.0 is increasingly taking place in traditional food production points. However, with the possibilities of using the internet, smart devices can be found in many more places as production costs decrease. Although the Internet of Things technology is a new concept, it can serve useful functions in many points of the kitchen. In this study, the concept of the Internet of Things and the application areas of this concept in the kitchen were tried to be determined within the scope of Gastronomy 4.0. At this point, a literature review was made and a compilation was made. When it is necessary to monitor many devices in the kitchen remotely, being able to give some commands is important both in terms of profitability and sustainability. In the study, the concept of the Internet of Things and how it works are emphasized and current solutions are compiled with the possibilities of use in the kitchen.

Keywords: Internet of Things, Gastronomy, Kitchen, Gastronomy 4.0, Technology

INTERNET STVARI (IOT) U KUHINJI PO KONCEPTU GASTRONOMIJE 4.0

Apstrakt: *Internet stvari* je jedan od koncepata koji je poslednjih dana sve popularniji. Kada se posmatra iz konceptualne perspektive, može se reći da ovaj koncept, za koji se očekuje da će biti upotrebljiv u mnogim sektorima, ima različite refleksije i u sektoru gastronomije. Posebno u ovim vremenima kada osećamo upotrebu interneta u gotovo svim oblastima našeg života, ono što se može uraditi uz pomoć interneta privlači pažnju istraživača. Zahvaljujući ovom interesovanju, otkriva se činjenica da internet i različiti uređaji donose novu perspektivu u gastronomski sektor. U ovoj studiji ima za cilj da napravi pregled literature o tome kako i u koje svrhe će se *Internet stvari* koristiti u kuhinjama u okviru Gastronomije 4.0 i kakve će pogodnosti pružiti. Sektor gastronomije je jedan od važnih marketinških alata za zemlje, društva i kulture. U ovom trenutku u industrijskim kuhinjama svakodnevno se pripremaju mnoga jela u skladu sa društvenim i individualnim zdravstvenim uslovima.

Zahvaljujući tehnologiji *Interneta stvari*, mogućnost informisanja o tome šta se dešava u kuhinji bilo gde i u bilo koje vreme može omogućiti realizaciju koncepta održivosti, koji je jedan od najvažnijih problema današnjice, kroz dobro planiranje jelovnika i upravljanje otpadom, posebno higijenom i bezbednošću hrane. Sa ovim konceptom, industrijske kuhinje mogu imati potencijal da dostignu mnogo bolju tačku u okviru ugljeničnog otiska i vodenog otiska. Vidi se da se koncept Gastronomije 4.0 sve više odvija u tradicionalnim mestima za proizvodnju hrane. Međutim, sa mogućnostima korišćenja interneta, pametni uređaji se mogu naći na mnogo više mesta kako se troškovi proizvodnje smanjuju. Iako je tehnologija *interneta stvari* novi koncept, može služiti korisnim funkcijama u mnogim delovima kuhinje. U ovoj studiji, koncept *Interneta stvari* i oblasti primene ovog koncepta u kuhinji pokušali su da se utvrde u okviru Gastronomije 4.0. Na ovom mestu je napravljen pregled literature i napravljena je kompilacija. Kada je potrebno daljinski nadgledati mnoge uređaje u kuhinji, mogućnost davanja nekih komandi je važna i u smislu profitabilnosti i održivosti. U studiji je naglašen koncept *Interneta stvari* i način njegovog funkcionisanja i sastavljena su aktuelna rešenja sa mogućnostima upotrebe u kuhinji.

Ključne reči: Internet stvari, Gastronomija, Kuhinja, Gastronomija 4.0, Tehnologija

1. INTRODUCTION

The Internet of Things is one of the concepts that has become increasingly popular in recent days. From a conceptual perspective, it can be said that this concept, which is expected to be usable in many sectors, also has various reflections in the gastronomy sector. Especially in these times when we feel the use of the internet in every area of our lives, what can be done with the help of the internet attracts the attention of researchers. Thanks to this interest, the fact that the internet and different devices bring a new perspective to the gastronomy sector has emerged (Alavi, Jiao, Buttlar, & Lajnef, 2018; Rejeb, Rejeb, Simske, Treiblmaier, & Zailani, 2022)

This study aims to make a literature review on how and for what purposes the Internet of Things will be used in kitchens within the scope of Gastronomy 4.0 and what kind of benefits it will provide. The gastronomy sector is one of the important marketing tools for countries, societies, and cultures. At this point, many meals are prepared in industrial kitchens every day in accordance with social and individual health conditions.

Thanks to the Internet of Things technology, being able to be informed about what is happening in the kitchen anywhere and at any time can enable the realization of the concept of sustainability, which is one of the most important problems of our day, by providing good menu planning and waste management, especially hygiene and food safety. With this concept, industrial kitchens can have the potential to reach a much better point within the framework of carbon footprint and water footprint.

2. GASTRONOMY 4.0

It can be said that the food and beverage sector is one of the areas affected by the development of technology. Especially the developments in the industry in the last two centuries have been affecting people's lives at an unprecedented speed. Making sense of these developments poses difficulties in various aspects. For this reason, classifying these developments is a critical point in terms of making sense of them. This classification process was done with numbers and this system first showed itself in the field of industry. Later, as in many fields, tourism and gastronomy also made names such as 1.0-2.0-3.0-4.0 for their own concepts. This system, which is used in revolutionary innovations brought by technology, also includes the concept of gastronomy 4.0, which means the fourth generation today (Liang, S. et al., 2018; Topsakal, Yüzbaşıoğlu, Çelik, and Bahar, 2018; Keskin and Sezen, 2021).

Gastronomy 4.0 is the reflection of the technological developments brought by the industry in the gastronomy sector. These technologies can also be called the comfort features they offer us in responding to people's requests. E-menus, animation and holographic promotions, computer and food interaction systems, 3D food and chocolate printers in the food and beverage sector are examples of the use of artificial intelligence in the gastronomy sector (Işık, Işık and Işık, 2016; Microsoft Launches New, 2007; Wasserstrom, 2018; Cecchini, 2018; Sebes, 2018).

3. INTERNET OF THINGS (IOT)

Today, with wireless connections (Bluetooth, Wi-Fi, etc.), mobility has increased, and computer-to-computer communication is no longer done only with desktop devices. While mobile devices are becoming indispensable for everyone day by day, the types of wearable smart devices are also increasing. Wristbands and watches worn on the arm, various smart glasses, various receiver, and transmitter devices placed in the trunk are examples of these. Various sensors (pressure, temperature, etc.) on these and many similar devices also collect data and process and give meaning to it. At this point, many devices that develop and communicate with each other collect data from each other in a way that will produce a result. The concept of the Internet of Things that has been put forward creates a new paradigm. These sensors are at the center of the concept of the Internet of Things, and all these digital devices provide comfort to people by communicating autonomously with each other (Maksimović, 2019).

The concept of the Internet of Things is a concept that can play important roles not only on a personal basis but also on an industrial basis. Since it is a concept where machines collect data and process this data by eliminating the margin of error of humans, this concept should be seen as a structure that enables a wide range of usage possibilities in many areas.

This structure consists of three different layers. The first layer is the perception layer, the second is the network layer and the third is the application layer (Sethi and Sarangi, 2017).

Perception layer: There are many data collection devices such as environmental sensors, infrared sensors, neural sensors, chemical or biological sensors in this layer. This data is collected in accordance with the purpose and transferred to the transfer stage. An example can be given by a smart watch worn on the wrist measuring oxygen data in our blood.

Network layer: It is also referred to as the transfer layer in some sources. Data coming from sensing devices are transmitted to the application layer using various transfer technologies (Wi-Fi, Bluetooth, 4.5G). In this layer, it is important for the data to go from the right source to the right source. An example is the transfer of oxygen data in our blood to our smartphone via Bluetooth.

Application layer: This is the stage where data coming from the network is converted into a format that users can understand. At this stage, it is displayed on the application interface in a way that is suitable for the purpose using various software. An example is the display of oxygen data in our blood in a form that we can evaluate in terms of critical values in the health application on our smartphone.

4. REFLECTIONS OF THE INTERNET OF THINGS CONCEPT IN GASTRONOMY

Sensors that can establish wireless communication in the relevant areas of the kitchen and thus collect various data in a way that can move in a very flexible area can be placed. This data can be easily monitored by the chef in charge via the application via the gateway. Thanks to the Internet of Things, it is possible to monitor emergency situations such as water flow in the kitchen, a fire or temperature increase, gas leakage, and to

notify both the responsible person's phone and the necessary units. In addition, carbon dioxide, humidity, and temperature control in the environment, as well as sudden temperature drops in refrigerators, can be monitored (Solution for Food, 2020).

With smart ovens that support Wi-Fi, devices connected to the gateway can be controlled remotely by cooks from anywhere in the world. Among the controls such as which cooking technique will be applied, which humidity level will be, how many minutes will it cook, features such as self-cleaning can be used to control remotely. In addition, with refrigerator cameras, it is possible to see whether vegetables and fruits are approaching their expiration dates and what is missing from the products in the refrigerator through the cooks' applications. Especially during the stock control phase, information such as the number of remaining ingredients and their expiration dates can be monitored via wireless sensors. Since waste management is one of the most important losses of food and beverage businesses, it is also thought to play a significant role in preventing this (Gupta, 2022; Albrecht, 2019).

Energy management is also one of the critical issues, especially for food and beverage businesses. This system, which shows itself in many areas from the management of ambient temperature to the adequacy of lights, from gas consumption amounts to the detection of water leaks, emerges as a phenomenon that has a potential benefit in every element used in the kitchen (Woodbury, 2022).

There are many platforms created using the Internet of Things, and some examples are given below.

Open Kitchen: It has emerged as a solution that uses the Internet of Things technology to instantly monitor and diagnose various situations for many kitchens equipment through a common application. Many conveniences, from recording data required by the HACCP system to creating instant alerts related to food safety, from energy management to process tracking, are offered through a platform (Open Kitchen Overview, 2022).

Particle: It can be explained as a solution that allows kitchen equipment traditionally used in the kitchen to be connected to the internet wirelessly with cards and sensors that can be programmed according to the desired purpose. For this purpose, the data to be measured from the equipment can be monitored through the application. Many businesses around the world have started to use this system (Build Intelligent Kitchen, 2022).

Food Pairing: Thanks to cameras and stocktaking programs in refrigerators and warehouses, chefs who know the ingredients they have thanks to the Internet of Things can also learn what kind of flavours they can create with the ingredients they have on hand thanks to this platform. Thanks to food pairings, new and creative flavours can be created in kitchens and the ingredients on hand can be used in the most beneficial way (Makinei and Hazarika, 2022; The science Behind, 2022).

Smart industrial kitchen equipment: Many equipment such as industrial dishwashers, ovens, freezers and refrigerators, grills, frying oil filter machines, coffee machines, vacuum machines that allow Wi-Fi connection are currently sold (Smart Kitchen Appliances, 2022).

5. CONCLUSION AND DISCUSSION

Although the Internet of Things is a new concept, it is seen that there are many possibilities of use in the gastronomy sector, as seen in the examples above. Many companies are conducting numerous studies on this subject. The most important feature to be seen in kitchens thanks to the Internet of Things is food safety and hygiene. Thanks to traceability, food materials can be prepared with the right planning. In addition, using the materials at hand efficiently is an important item in kitchens in terms of sustainability and profitability (Nayan, Saha, & Kibria Ferdous, 2022; Bouzembrak, Klüche, Gavai, & Marvin, 2019).

It is seen that there is a great benefit on a social, individual and company basis thanks to the internet of things. With this benefit, every segment will be able to benefit from its advantages. However, no study has been found in the literature research that clearly investigates these benefits. At this point, in future studies, especially between traditional kitchens and kitchens using the internet of things technology, factors such as profitability, time efficiency increase, guest satisfaction increase, employer satisfaction increase, employee satisfaction increase, or investment return period can be investigated and contributed to the literature. In addition, a guide can be prepared on issues that require consultancy such as the acceptance period, form, or technical processes by businesses. It can also be said that this technology will be used in many more areas in the future and gastronomy, one of the most essential elements of cultures, will naturally benefit from this.

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