

Intelligent Information System for Remote Customer Service

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Abstract

The research is devoted to developing a prototype of an intelligent information system for remote customer service. The existing approaches, features of the problem situation, and software products for minor maintenance are investigated. Methods and technologies for implementing the intellectual component of the system of remote customer service are selected based on the existing ontology of analysis Big Data. Data Mining methods are chosen as a basis. The decision tree method is used to provide product selection recommendations. For real-time decision-making, predictive modeling, business rules, and self-study are used to make an informed decision based on the current context. The marketing tool for forming a consumer loyalty program (discounts, prizes, bonuses, etc.) is carried out using the developed set of production rules. An object-oriented paradigm is used to design an information system. The requirements for the implementation of the application are substantiated. The implemented prototype of the intelligent information system for remote customer service works only online. It allows you to reduce contact with people, save user time or make a purchase.

Keywords 1

Data Analysis, Big Data, information system, logistics, production rules, remote customer service, project

1. Introduction

The introduction of information technology allows us to offer new types of services to customers. Thanks to the introduction of information technology, companies can successfully compete in the global market. The faster the information is published and implemented, and the more successful the company can achieve. Information technology saves time and reduces production costs.

The use of information technology during isolation provides even more significant and sometimes even necessary benefits. The main factor is limiting the number of people. Both employees and customers. However, there are many other problems and difficulties: server overload due to heavy workload, logistical challenges, wage issues for workers in isolation. Allowing the user to continue to use all the services he used before, without isolation, has become very important and relevant.

Almost all delivery market operators report a significant increase in workload. In April 2020, Nova Poshta delivered 12% more parcels than in March. At the Meest in April 2020, the number of packages from e-commerce operators increased by 45%. They were sending to Meest post machines [26], which became the safest way to receive parcels during the epidemic, increased by 40%.

Glovo in Ukraine reports that the number of active Glovo users has more than doubled in March-May. This trend is explained by the fact that quarantine has forced people to change habits and more actively use online services, delivery services, and e-commerce. In the categories “Supermarkets” and “Pharmacies”, the number of orders in the Glovo application for the first month of quarantine increased by 40%. At the same time, the share of non-cash payment, which before the quarantine was about 50%, reached 64% as of mid-May.

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Most customer service companies still do not address logistics issues such as delivery or fast order fulfillment. Due to the almost complete absence of physical customers, many facilities are closed and filed for bankruptcy.

The main task of most companies is to adapt to the operation during quarantine periods from COVID-19.

2. Literature review and research relevance

The problems of applying intelligent information systems for remote customer service are investigated in a wide range of scientific works. An essential element of the process of such intelligent information systems is the construction of methodology. In particular, Kraig Delana, Nicos Savva, and Tolga Tezcan [34] propose applying a methodological approach based on queuing theory and game theory to stimulate optimal consumer behavior at reasonable prices. Chun Lin He [10] uses a similar methodological approach.

Chunting Liu, Guozhu Jia, and Jili Kong [15] substantiate the advantages and feasibility of building an intelligent information system for remote customer service based on Big Data analysis. In particular, the authors confirm the feasibility of using Big Data technology to improve the process of identifying information about consumer requirements, which significantly increases the level of specification and significance of such requirements. Also, the application of the Big Data method allows to obtain new market opportunities and maximize the retention of confirming consumers, confirmed by Renas Rajab Asaad, Hawar B. Ahmad, Rasan Ismael Ali [2]. Such analysis of customer behavior is based on real-time data processing based on Big Data technology. It provides effective improvement of service quality for consumers, which provides a synergistic effect of “win-win” when consumers receive constant satisfaction of their needs and improved service, and entrepreneurs – increase number of consumers and income received. Ganjar Alfian, Muhammad Fazal Ijaz, Muhammad Syafrudin, M. Alex Syaekhoni, Norma Latif Fitriyani, Jongtae Rhee [1] carried out empirical confirmation of such results of application of information systems for the purpose of remote service of consumers.

Such information systems are used in various economic activities, in particular in the food industry. F.G. Maitakov and A.Ya. Yafasov give an example of developing an information system for remote customer service in food using collection, storage, and Big Data analysis [20].

It is possible to present the production of restaurant products in the form of a standard cycle form two stages: initial (stages of purchasing food (raw materials or semi-finished products), their receipt and subsequent storage, subsequent storage, transfer to the primary production cycle, direct cooking) and final (sale to the consumer).

Ensuring the stability of this process and optimizing costs and efforts, which are the main tasks to be solved by the logistics department of the enterprise.

Today, Ukrainian enterprises are doing business in significant instability of the economic environment. It makes them necessitates the search for highly efficient methods and ways to manage the enterprises' activities. One such method is logistics. Logistics allows reaching a qualitatively new managing level for the enterprise's material, financial, and information flows. Also, it helps to improve the final results of its economic activity and ensuring a stable market position.

Logistics is the planning, implementation, and control of technologically and cost-effective processes of movement and storage of goods, materials, semi-finished and finished products, and the transfer of relevant information from a place of production to a place of consumption following consumer interests. The “place” component in the marketing complex is almost entirely determined by the work of the logistics service of the enterprise, which largely determines the level of customer service. However, it can be noted that logistics has a significant impact on other components of this complex. Logistics is the essential component in the basis of customer service because, ultimately, it is the actions of this service that determine whether the buyer will receive the necessary goods or not. The company's management cannot promote the product or develop a pricing policy until it is sure that customers can find the product they need in the store or warehouse, no matter what time they come.

It is essential to choose a decent contractor who will provide quality, inexpensive and fast freight services, thus ensuring the uninterrupted supply of food, equipment, and much more.

Suppose it is necessary to have well-established logistics of facilities and the absence of the need to create and maintain their fleet by their efforts. In that case, it is most appropriate to involve external transport companies that have the necessary types of vehicles and provide professional transportation services.

2.1. Analysis of known means of solving the problem

Today there are many offers for the customer to be able to order completely different products. Starting from the TV, you can end with a delicious dinner, delivered on time and warm.

Deliveries can be performed both by the restaurant and by an external service operator [6, 14, 23, 34].

The most popular applications of independent operators used in Ukraine are Uber eats, Glovo, Rocket, Delivery Club, Sushi WOK, Eda.UA, Bolt Food [25]. Restaurants are already integrated into their information applications, and the services themselves are engaged in purely delivery.

Uber Eats. Uber Technologies Inc. Uber is an American international public company from San Francisco, which has created a mobile application of the same name for finding, calling, and paying taxis or private drivers and food delivery. Uber [35] helps the customer reserve the car with the driver and monitor its movement to the specified point. Although the number of downloads has already exceeded 100 million downloads, this is not the leading service.

It is very convenient to sort by sections. It is possible to choose the partition with advantageous offers or family dishes, which can be convenient if you order for the family. You can add a payment method or edit your data in your account settings.

Rocket is a Ukrainian service of food and products delivery from supermarkets using the mobile application [30]. Rocket provides the ability to order delivery from the grocery store. It is convenient that at the choice of the address, users can see all establishments. If you choose a facility, you immediately can see how long it will take to be prepared and delivered.

Glovo is a Spanish startup founded in Barcelona in 2015 [9]. Glovo is an on-demand courier service that buys, picks up, and delivers goods ordered through the mobile app. It has several new sections: fast delivery, medicines, and gifts. Also, for some cases, filtering is very convenient (**Figure 1**).



Figure 1: Glovo interface

Today, most programs have much in common. Almost all information technologies it is possible to use in one way or another in most applications. There is order history, whatever they could repeat the search facility, many filters, order status. There are fixed prices for delivery, and there are applications where the delivery cost depends on the distance to the facility.

We can also mention R-Keeper V7 - a trademark of UCS [29], which sells software and firmware designed primarily for integrated restaurant automation.

The professional delivery system based on R-Keeper V7 allows you to automate ready meals of its production and other goods to consumers of any format - from small production to an extensive network.

The program processes orders received both by phone and via the Internet, registration, and paid on the facility's website or any coalition Internet resource, including those made from mobile devices. The system consists of the main modules Operator and Dispatcher. It also allows working in the Call Center mode, which provides network establishments accepting orders in the uniform center and their automatic distribution on the food enterprises according to delivery zones. Creation of the menu, formation of the prices, the definition of the restaurants participating in service, control of financial indicators are made in managerial parts of R-Keeper.

A professional delivery automation system based on R-Keeper V7 is an excellent tool for organizing the delivery service of ready meals in the restaurant. It helps to monitor all stages of work reliably and receive the necessary reports for effective management, including online and remotely via the web interface.

2.2. Features of the problem situation

The ability to deliver goods even at night is the most important feature among the offered services [21, 25]. In second place – personalized proposals, which depend on various factors (**Figure 2**).

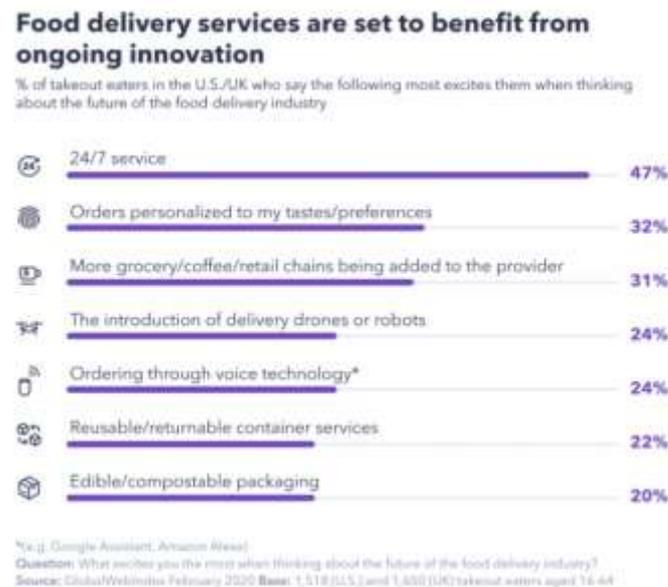


Figure 2: Advantages of implementing various functions

People love to receive gifts as well as receive discounts, vouchers, and other promotional offers. Vouchers and coupons for your meals can encourage online customers to visit your physical restaurant.

Recommendation lists - display recommendations on the home page according to the weather, mood, or cuisine. Customers will be happy to see popular breakfast/lunch/snack products without looking for them when they open the morning/afternoon/evening program.

Developers use different systems of recommendations. However, in most cases, there are common attributes that make the lists of offers clear and exciting to the user:

- good reviews on products;
- time of day when the user uses information services;
- history of user orders;
- the cost of pre-orders.

These are just some of the reasons why the product can be recommended. It is essential if the service applies to several different restaurants. In such systems, quite often “Recommended for you” – it’s just advertising offers.

There are many essential aspects in the direction of customer service in the field of nutrition. However, there are key features that improve information services:

- *registration* – adding users should be short, secure, and uninterrupted;
- *profile management* – customers, administrators, restaurants, and delivery agents should be able to update their profiles constantly;
- *recommendation lists* – display recommendations on the home page according to preferences;
- *homepage settings* – display of favorite restaurants, dishes, and frequently ordered dishes on the home page;
- *placing an order and placing an order* is a standard feature, but you need to keep innovating;
- *order tracking* is the essential function that can attract a customer;
- *payment* – integrate all popular payment gateways so that customers can pay using the tool of their choice;
- *ratings and reviews* – works on three levels: restaurant, dish, and delivery agent;
- *notification* – you need to inform your users when their order should arrive, about the latest offers;
- *loyalty program*.

A review of the existing implementations of the problem's solution showed that the chosen research topic is relevant and requires developing an intellectual component of the application. Today, the ability to order products remotely is a necessity. An alternative information service takes into account the benefits of existing applications. The task of the developed service is to allow the user to order products that interest him remotely conveniently. The application should provide online payments and delivery to different locations, depending on the client's location.

A feature of the developed information system for remote customer service is order fulfillment in real-time with more detailed characteristics. It is also proposed to use a flexible delivery system, which depends on the customer's area. The intellectual component of the system contains many rules for providing recommendations on product selection and the formation of a system of bonuses. The application uses interactive banners. We have selected the Celentano restaurant chain has to develop and test the prototype application.

3. Development of the project of information system for the organization of the product delivery

With the intensive development of business, to maintain the competitiveness of the enterprise and the processing of significant amounts of accumulated structured and unstructured data, information technology Big Data assists. Systems analysis of the problem situation showed that we have many cheap sources of unstructured information: user orders, user location, and product. The ontology of Big Data analysis built-in [17, 18, 31] allows choosing methods and technologies for the realization of the intellectual component of the system of remote customer service. To solve optimal product selection, provide recommendations, and for example, a decision tree method is used to provide product selection recommendations.

To make decisions in real-time to the predicted modeling, business rules and self-study adopted a reasoned decision based on the current context. Formation of the bonus program (discounts, prizes, bonuses, etc.) is carried out using the developed production rules, for example:

Rule 1:

IF the client bought products worth more than UAH 10,000 **AND** constantly uses the company's services for less than six months, **THEN** he receives a 10% discount on all goods and services.

Rule 2:

IF the customer bought products worth more than UAH 15,000 **AND** constantly uses the enterprise's services for less than a year, **THEN** he receives a 15% discount on all goods and services.

Rule 3:

IF the customer bought products worth more than UAH 20,000 **AND** constantly uses the company's services for over a year, **THEN** he receives a 20% discount on all goods and services.

Rule 4:

IF the customer has made a one-time purchase, **THEN** he receives a 5% discount on all goods and services, etc.

The system combines recommendations with discounts to increase user interest in purchasing goods.

Rule 5:

IF the product has good consumer feedback **THEN**, it is included in the user's list and receives a 10% discount.

Recommendations are also formed depending on the period of the day of using the program. Many establishments have products that are only available for breakfast or business lunches and available for sale from 13:00 to 16:00. Accordingly, the system will also change the recommendations.

IF the client submits a request through the application from 13:00 to 16:00, **THEN** the business lunch menu is recommended discount plus 5%.

User pre-orders are also analyzed to form recommendations. These are one of the main factors. For example, if the user has always ordered pizza without fish, the system will not offer "Tonno" pizza containing tuna.

It is also essential to consider the previous cost of orders for different groups of customers, edit orders, and add something personal, increasing its price.

The set of rules forms the knowledge base and is constantly updated and supplemented.

This project aims to create a system that can improve the conditions for the user who wants to use the delivery of "Celentano" products remotely.

It is possible to use the system in applications with the operating system iOS or Android and conceptually when creating web applications. The client will receive all the navigation of the institution in the online version. The content menu system is used for navigation. The menu is a page with blocks that have hyperlinks for a more detailed overview of the product.

The system input is the result of authentication. Authentication is not required, although it is desirable, as the system remembers the address and payment details when logging in.

For security reasons, there are rules for authorization and password creation, namely:

- password length not less than six characters;
- there must be Latin letters, at least one capital letter;
- the ability to use different characters.

Additional requirements:

- to use a DBMS for data management;
 - for Apple mobile devices, iOS 6 and newer operating systems;
 - for Android, Android 4, and later;
 - the time in the phone settings is turned on automatically. It is done for correctly displaying time in the application when there is no Internet after the successful order. It works if the user has successfully placed an order, this requires the Internet;
 - for web versions – web browser: Internet Explorer 7.0 and higher, or Firefox 3 and higher, or Opera 9.4 and higher, or Safari 3.2.0 and higher, or Chrome 2 and higher;
- cookie support.

When implementing an information system project, we have built the UML (Unified Modeling Language) diagrams which simplify the understanding of the created information system project [3, 4, 5, 11, 24]. Charts increase project support and facilitate documentation development. Consider several constructed diagrams of behavior and interaction. Use-case diagram developed to describe system functions (**Figure 3**) – a representation of user interaction with the system, showing the relationship between the user and the various cases of use in which the user participates.

Four actors are represented: "Customer", "Restaurant", "Courier", "Manager". The usage diagram shows the following objects:

- external entities: "Customer", "Restaurant", "Courier", "Manager";
- data flows: "Login", "Information verification", "Product provision", etc.

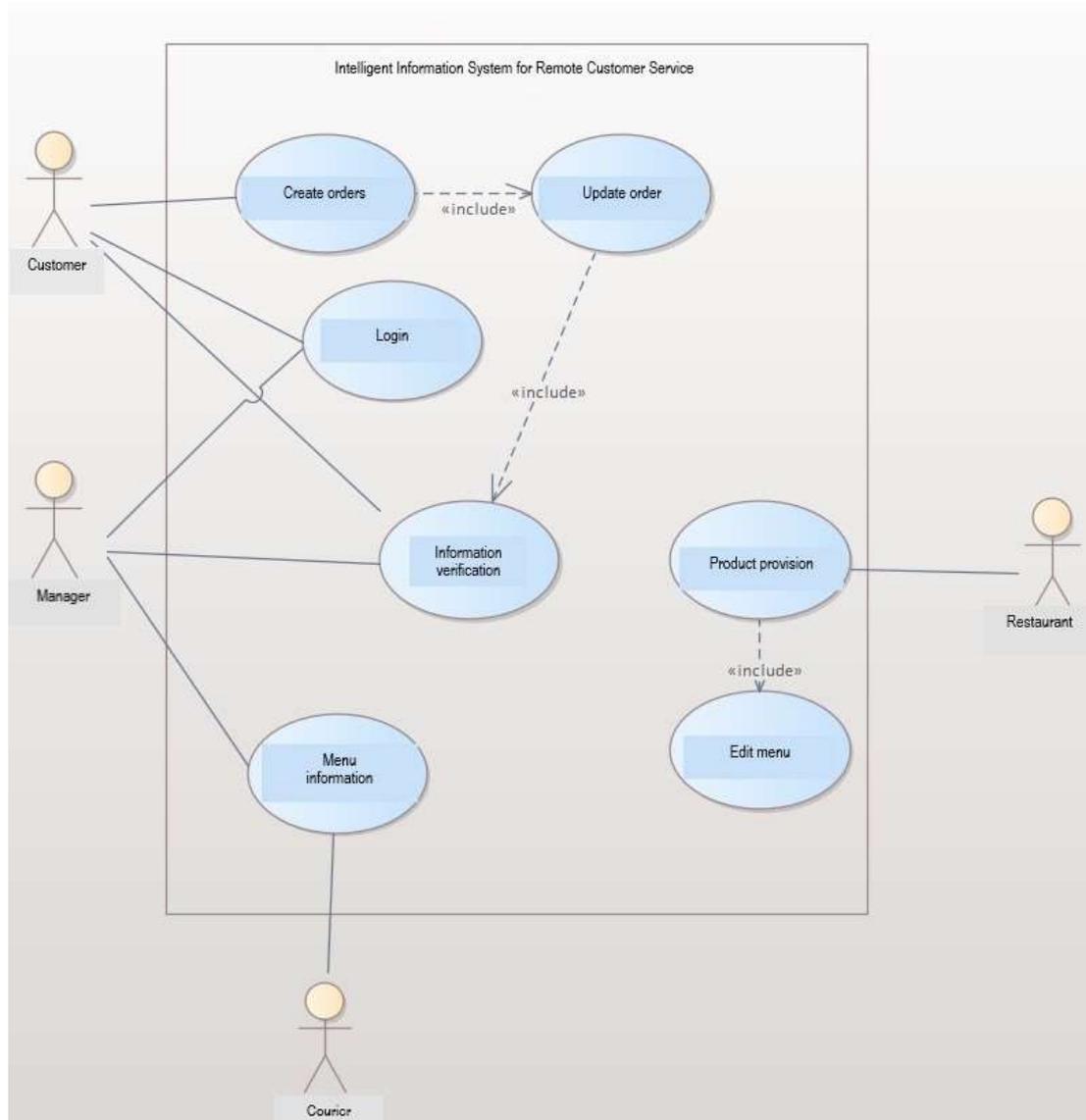


Figure 3: Use Case Diagram

The class diagram shows the general structure of the class hierarchy system, their interactions, attributes, methods, interfaces, and relationships between them. The project contains four classes (**Figure 4**):

- User;
- Restaurant;
- Courier;
- Order.

The Class User contains:

Attributes – user address, name, surname, information for authorization, and UserID, which is used by the restaurant for orders, as well as the courier.

The Restaurant class contains the following attributes: order information, product information, prices, and time of order realization. This is done so that the courier can do everything on time.

The Courier class contains the following attributes: Order number, as well as UserID, it is required to fulfill orders to the desired user, and prices and delivery time to satisfy the order on time and withdraw payment if you choose the payment method - cash.

The Order class contains the following attributes: CourierID, which would give the required courier the correct order. There are also attributes of the order number, userID, order price, and status.

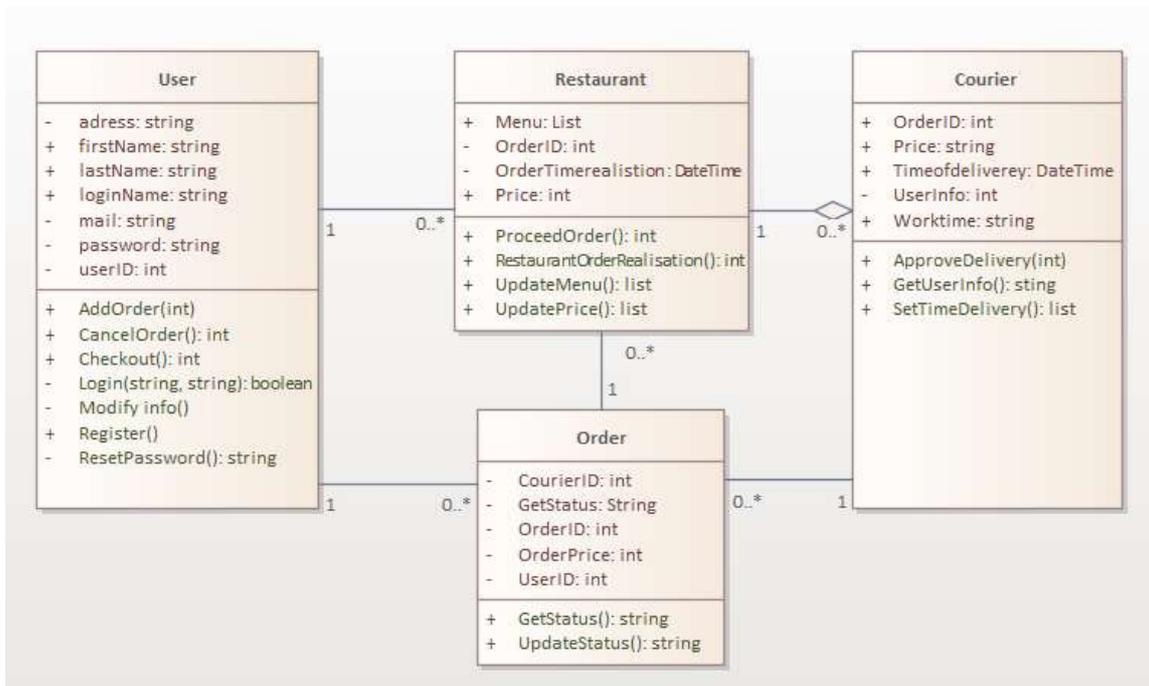


Figure 4: Class diagram

The UML Collaboration diagram shows the links between objects in the system. Collaboration diagrams (**Figure 5**) represent which elements each interacts with best, but sequence diagrams show the order in which the interactions occur.

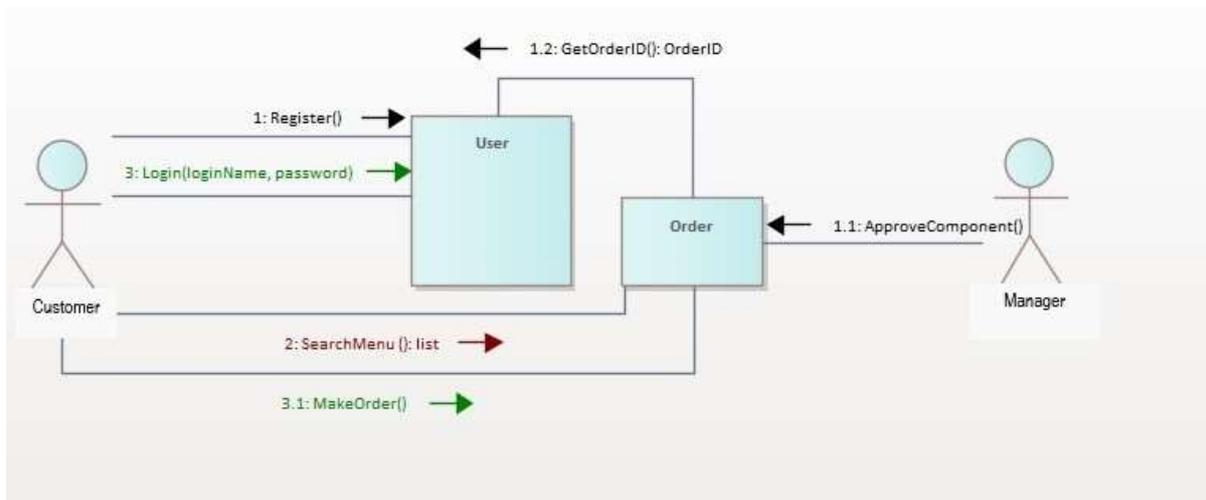


Figure 5: Diagram Collaboration of customer-manager

A sequence diagram is a form of interaction that displays objects in more detail and demonstrates communication between objects. You can see all the events in the system in the sequence diagram (**Figure 6**).

The main components are User (Information component) and Order, and the essences are the Courier, Customer, Manager and the Restaurant itself. The customer creates and provides information used by the manager, and he can edit and confirm it: the restaurant offers and updates order information. The task of the courier is to accept the report and fulfill the order.

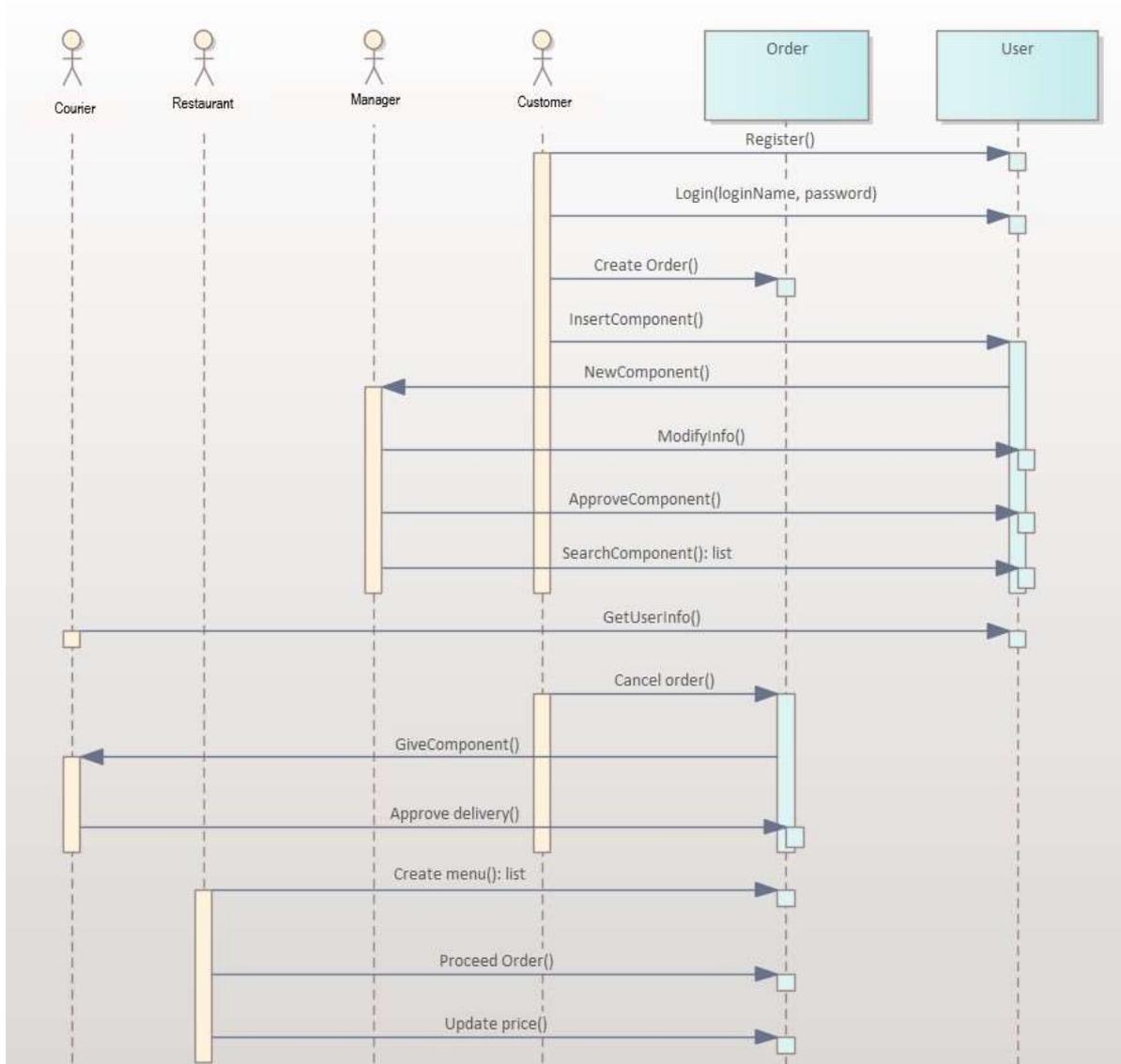


Figure 6: Sequence diagram

State Machine diagram represents the state of a system or part of it infinite times. This diagram is a behavior diagram, and it reflects the use of the final state transitions. The primary state of this system is waiting and receiving data. The system provides the opportunity to log in as a guest or login. The user can choose how to place an order, but the finished result will be obtained only when the system checks whether the payment was successful.

Activity Diagram reflects how the system responds to retrieve data for order (**Figure 7**). It is also shown that authentication is not required, although it is desirable. Saved user data is a way to improve the user's use of the application.



Figure 7: Activity diagram

A component diagram is a communication tool between developers and system stakeholders (**Figure 8**).

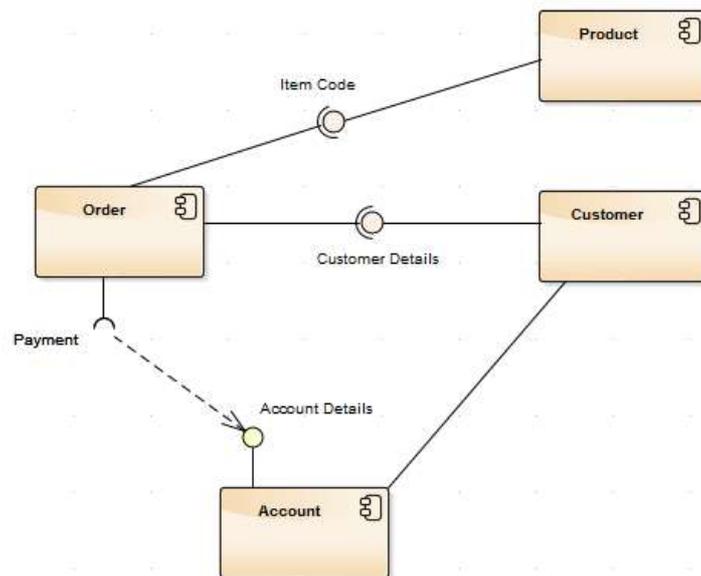


Figure 8: Component diagram

The diagram shows the combined components of the order, the user, the account (UserID), and the product itself ordered by the user.

In UML, deployment diagrams visualize the static aspect of physical nodes and their relationships. The deployment diagram contains (Figure 9) a Component, a Node, a link of Dependency or manifestation, Connection, Artifact.

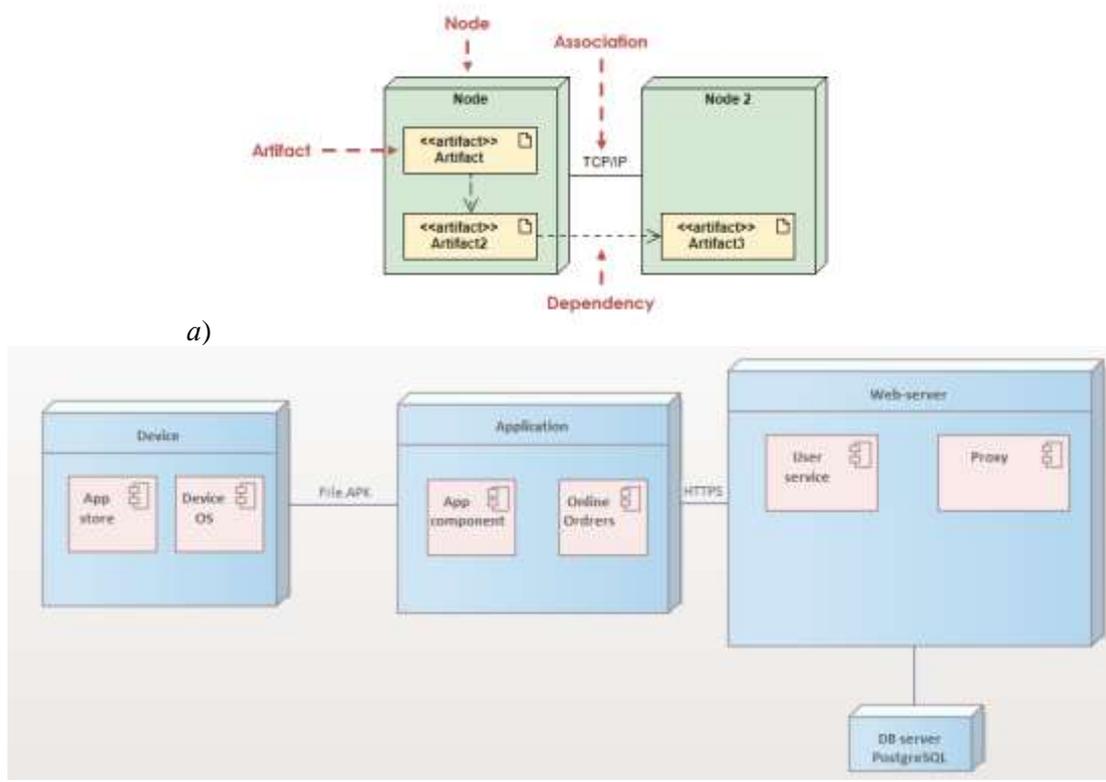


Figure 9: Component diagram

4. Description of implementation tasks

During quarantine, expectations from the created application are apparent. Compensation for the absence of physical consumers in facilities is critical at the quarantine time. In addition, it is essential to use logistics correctly. For the successful implementation of such systems, the company must perform its tasks on time.

Requirements for project information system:

- graphic implementation of the application;
- the integrity of design;
- an interface that will be intuitive for the user;
- application optimization in order not to load mobile devices;
- possibility to order products as a guest;
- delivery system intelligence, which depends on the user's location.

Due to existing business analytics standards, the following requirements apply to the project implementation of the technical environment, software, and platform through which the system is implemented and deployed [16, 32, 37]:

- Java JDK 7 or later;
- Maven 3.3;
- PostgreSQL [27];
- library Curl.

Apache Maven [8, 33, 39] – a framework for automating the compilation of projects based on a description of their structure in POM (Project Object Model) files, which is a subset of XML. The Apache Software Foundation has published the Maven project, formally part of the Jakarta Project.

Maven provides declarative, not imperative. The project description files contain its specification, not individual execution commands. All file processing tasks are described in the specification. Maven has used to building and managing projects written in Java, C #, Ruby, Scala, and other languages [12, 13, 19, 28].

Curl – is a network tool used to transfer data between server and client curl using HTTP, FTP, TELNET, and SCP.

We can execute curl commands from Java, using ProcessBuilder - an auxiliary class for building instances of the Process class.

The application uses Google services to determine the location of the user and the nearest facility.

Once the user has installed the mobile application, it launches it and enters the main menu (**Figure 10**). One of the “Celentano“ is selected in the main menu, and the possibility of authorization, which is not obligatory, but provides additional convenient opportunities, is right next to it. For example, remembers the address, provides improved recommendations. Following four tiles: Favorite, Discount, Trendy and More. If you click on a favorite but not being authorized, the application will take the user to the authorization section. There is also a notification icon, and this icon is to receive delivery information after confirming the order.

Here are the recommendations. The system selects, first of all, starting from already executed orders. For this purpose, it is necessary to carry out authorization. Also, the recommendation may change depending on the time of ordering.

Below are: home page, my order, search, and my profile.

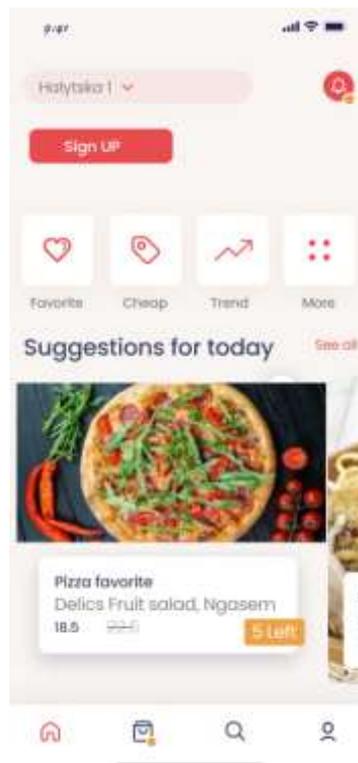


Figure 10: Main menu

We simulate a situation where the user clicks “Sign UP” (**Figure 11**). There are several options in this section: registration, authorization, or continue as a guest. To register, you must enter the password twice to avoid mistakes, and the password must contain both Latin letters and numbers.

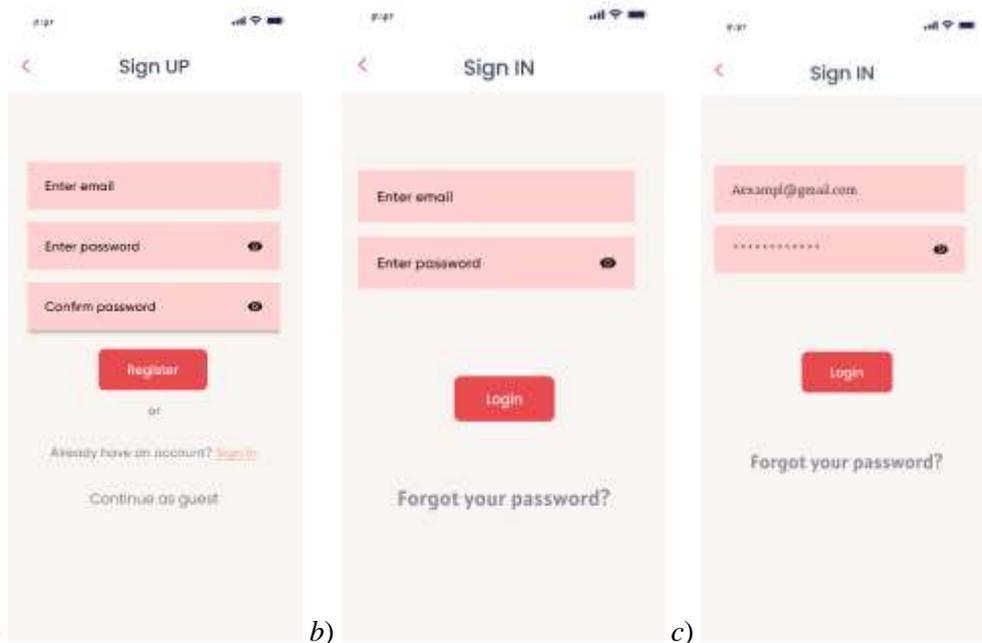


Figure 11: a) Registration menu; Authorization menu: b) step 1; c) step 2

The user has already registered himself, so he selects “Sign In” (**Figure 11**, b, c).

Also, conceptually, a design was developed in which authorization will be available through social networks (**Figure 12**).

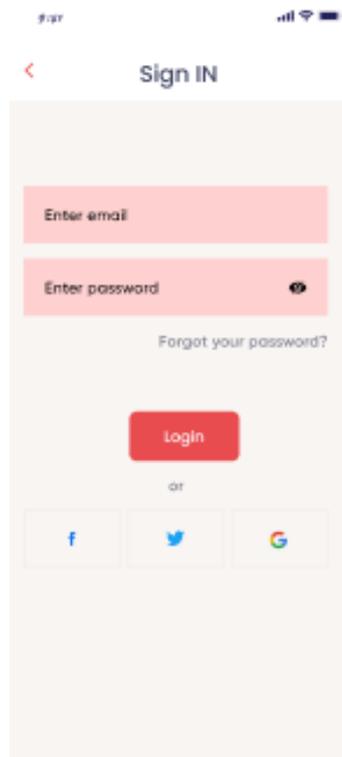
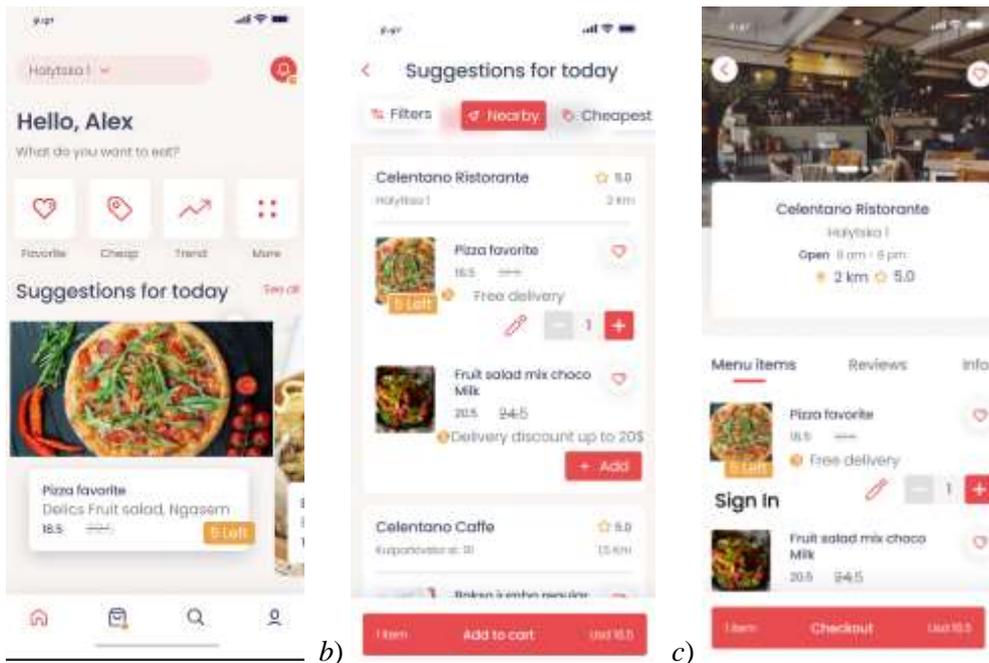


Figure 12: Authorization through social networks

For implementing such a feature, the user has to make an additional request to the authorization service. After which, the user has to wait for the information from the server’s response.

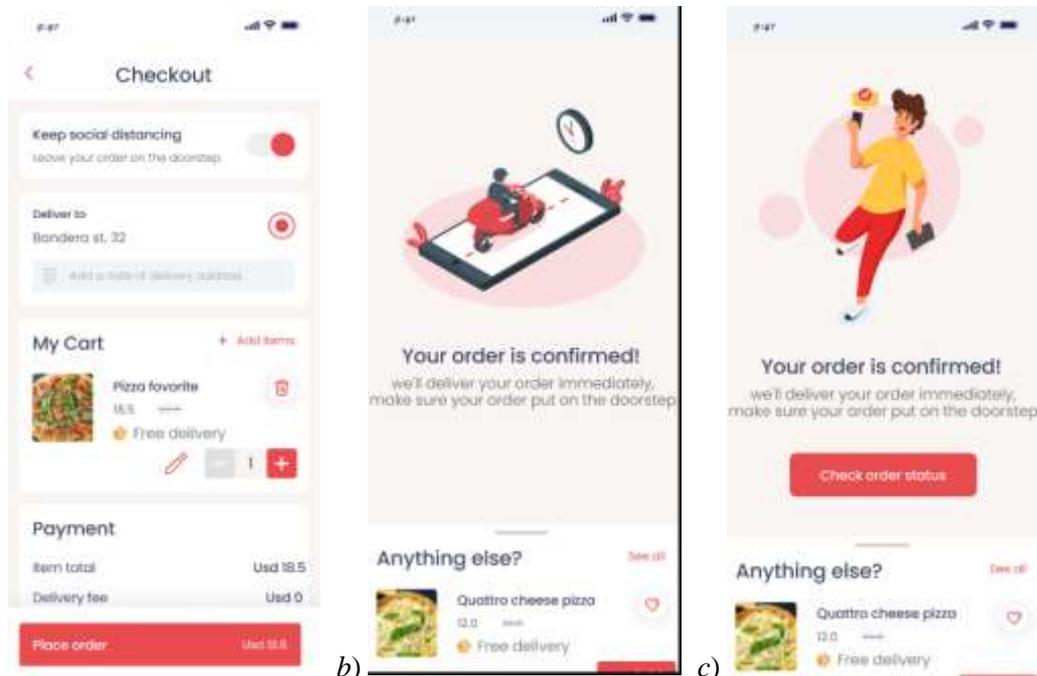
Then the user is in the main menu but already authorized (**Figure 13**, a).



a) The main menu after authorization; b) recommended; c) guest

Next, choose a product. Choose what the system offers. In addition, pay attention to the fact that the proposed dish has a discount (Figure 13, b). If you open this section as a guest, there will be an icon that still offers to log in (Figure 13, c).

We decide to order only “Pizza favorite” and go to the basket (Figure 14).



a) basket; b) the order is confirmed; c) order with status tracking

We have added the ability to keep a distance. There are several options for implementing this feature. One of them is online payment. In this case, the courier will simply leave the order at the door. Or the courier will call back when he approaches the house and offers that the client would go down himself. It will also protect a person from various diseases. Because the user has already logged in, the address is automatically displayed. After checking the order, click “make an order”. The application issues a

message about order confirming (**Figure 14, b**). Also added the ability to observe how delivery is performed (**Figure 14, c**).

5. Conclusions

We have confirmed the relevance of solving today's problem situation during the research of methods, technologies, and analogs of remote customer service systems. The degree of applicability of the designed information system in Ukraine is investigated. The peculiarities of logistics in the field of service and its model were also studied. An assessment was made of how circumstances have changed as a result of isolation and quarantine. As of the end of 2020, the task of developing an information service to solve problems with product delivery remains relevant. A comparative analysis of the analogies of the information system available today revealed their advantages and disadvantages.

The peculiarity of the developed intelligent information system is the use of banners and the ability to provide suggestions to the client based on the analysis of service optimization factors. We have used Data Mining methods as a component of Big Data analysis for implementing the intellectual feature. The decision tree method is used to provide product selection recommendations. For real-time decision-making, predictive modeling, business rules, and self-study are used to make an informed decision based on the current context. The formation of the bonus program (discounts, prizes, bonuses, etc.) is carried out using developed production rules.

We have constructed various types of UML diagrams using UML diagrams and object-oriented methodologies to detail project tasks. Describes the set of requirements for the information system that are necessary for the implementation of a particular task and selected the operating system for the operation of the system. The expected effects from the system implementation had special attention in the research.

The intelligent information system consists of a mobile application that is for everyday usage. The information system works only online and allows the user to order goods without visiting the institution.

Using this system, the client will receive all the navigation of the institution in the Internet version. The client can use the content menu for navigation. Before the release of the application, software testing was done according to Apple's requirements.

Implemented prototype of an intelligent information system for remote customer service allows you to reduce contact with people, save user time or make a purchase. Without the need for special knowledge, the user can intuitively place an order remotely in the popular restaurant chain "Celentano". There is possible to choose the place of order. The customer will receive recommendations on service and products to order. The application allows you to create a bonus program for each type of user. Such applications increase competition and improve the level of service provided to the end consumer.

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