



## **High-Level Design Report**

### **CS 491: Senior Design Project**

#### **Toproffer**

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# **1. Introduction**

## **1.1 Purpose of the system**

For a couple of years, the status of the Turkish economy has deteriorated. Inflation has been increasing among these years and Turkish Lira has been losing its value against foreign currencies especially American Dollar, and Euro. Thus, the prices of all kinds of products of all kinds of industries (such as technology, fabric, etc.) have been explicitly increasing. Specifically, the increasing price of the food and beverage industry has a huge effect on peoples' daily lives. When it comes to socializing, especially with friends whether it is a special day or not the economy side of having fun sometimes becomes a burden on one's shoulders. Therefore, restaurants have special campaigns in order to attract their potential clients to visit their restaurants. They put their low priced or under-sold products to the campaigns for a specific time interval. However, there is no way to announce their campaigns to a social platform except social media to the possible customers. Therefore Toproffer came as an idea to help people to save their time and preserve their economy with less effort compared to searching restaurants blindly on the streets. In a sense, Toproffer will bring the streets' view in a similar way as Google Maps does to the users, in addition to that it will act as assistance for finding promotions related to restaurants.

## **1.2 Design goals**

### **1.2.1 Usability**

- The program is easy to use for all user types and provides an easy-to-use and user-friendly interface.
- During the first interaction with the website, Toproffer is easy for the user to become comfortable with and able to use the user interface.
- Toproffer is easy to remember the user interface and how to use it with its console at the bottom on subsequent visits.

### **1.2.2 Compatibility**

- Forward and backward compatibility is important for Toproffer by the choices of the system design applications.

### **1.2.3 Customer Needs**

- Toproffer is focused on customer needs as explicit needs and also latent needs.
- Product gets data from the accounts and can create new campaign related to customers needs.
- Product organizes the needs of the customer with its machine learning algorithm.

### **1.2.4 Extensibility**

- Future of the Toproffer is not underestimated by the designers.
- All the data of customers and users are stored for the future releases and updates.
- The product can get new features with ease.
- All the system design is open to future additions.

### **1.2.5 Efficiency**

- Toproffer support the user.
- Toproffer is coherent, compact and sequential.
- Efficiency effectively reduces the amount of wasted resources used to generate a certain number of goods or services (output).
- Adopted a High-Performance Mindset.

### 1.3 Definitions, acronyms, and abbreviations

- **Campaign:** Promotional strategies are those aimed at bringing in more revenue by running deals and discounts, and using ads in restaurants to reach out to customers
- **Client:** A person who receives services
- **Customer:** A person who buys the product
- **User:** Restaurant owners, clients, customers and observers
- **Easy-to-use:** Ease of use is a simple concept – it is a measure of how convenient it is for its intended consumers to use the finished product.
- **User-friendly:** Consumer-friendly defines an easy-to-use hardware or software interface. It is "good" to the consumer, meaning understanding or comprehension is not difficult. While "user-friendly" is a subjective term, some common attributes can be found in user-friendly interfaces.
- **Console:** Makes easy use for customers when they open the first interface.
- **Forward compatibility:** Forward compatibility or upward compatibility is a design feature that enables a system to accept input for a later version of itself.
- **Backward compatibility:** Backward compatibility is a property of a system, product or technology that allows interoperability with an older legacy system or with input for such a system, especially in telecommunications and computing. Compatibility backward is sometimes referred to as compatibility downward.
- **Latent needs:** Latent needs can be described as a need or expectation that can not be met because a product or service lacks information or availability. Or, in plain English, a latent need is a problem not understood by a user or client.
- **Customer needs:** Consumer needs are things a consumer in a product or service requires, needs or expects.
- **Machine learning algorithm:** Machine learning algorithms are programs that adapt to perform better as they are exposed to more data (math and logic). The "learning" aspect of machine learning means that these algorithms

change the way they process data over time, as much as humans change the way they learn to process data.

- **Updates:** An update is new, improved, or fixed software, replacing older software versions. Updating the operating system, for example, upgrades it with the new drivers, device services, and security software. Updates are often issued free of charge by the software publisher.
- **System design:** System design is the process of determining a system's elements, modules, interfaces, and data to meet specific requirements. System creation is the process of creating or altering structures together with the procedures, methods, models, and methodologies that are used to create them.
- **Coherent:** Coherence is an ideal wave property that allows interference to be stationary (i.e. temporarily and spatially constant).
- **High-level design:** High-Level Design (HLD) is the overall system design for the layout of the system and the design of the database.
- **Design goals:** Design goals are development priorities. Usually, stakeholders rely on these as parameters for assessing product alternatives and analyzing design outcomes
- **System mapping:** A system map is a graphical representation that displays all the different actors involved in service delivery and their relationships (e.g. material flows, resources, information, assets, records, etc.) in one single frame.
- **Boundary condition tests:** Research has shown that experiments examining boundary conditions are more effective than tests not investigating them. Boundary conditions are cases that exist immediately on, above or below the equivalence groups of input and output.
- **User interface:** The user interface (UI) is the point of contact and communication between people and applications.

## **1.4 Overview**

Toproffer's high-level design is proposed in this report. It explains the purpose of the system and its design goals. Computer and device architecture was subsequently proposed while using machine decomposition and system mapping of hardware computer. Eventually, access control and system protection was studied under global device control and boundary conditions.

## **2. Current Software Architecture**

Since we have strong competitors in the market and some of them dominated the sector in different ways we got inspiration from them because domination led people to get used to their user interface. We all decided that Toproffer should attract people and be more user-friendly. We influenced by WhatsApp, Instagram, Yemeksepeti, and Getir. WhatsApp and Instagram are the most worldwide used applications. We get the page switching feature and template from them. I mean by the template is the profile page is on the most right of the pages, the main page is located on the most left page and other common designs of WhatsApp and Instagram. The main page includes only a map but you can choose the restaurant by filtering or not. We thought it would be appropriate if we put the filtering option on the right upper side corner. Other than design issues we concluded which framework to use. For implementation, we started to learn Dart. At the beginning of the next semester, our goal is finishing the main pages of application according to mockups. So we will implement the database according to our development in user interface.

## **3. Proposed Software Architecture**

### **3.1 Overview**

In our system architecture, we divided our system into several subsystems with their interactions with each other. System decomposition aims to present the structure of systems and subsystems in detail. The architecture contains also the representation

of a system, including the mapping of functionality onto hardware and software components, a mapping of the software architecture onto the hardware components and the user interactions with these components. We mentioned about the persistent data management and how data are managed in our system. This part is very important that we need to manage the data properly and without any flow because we are generating our machine learning algorithm according to these data. Then we proposed our access control and security, how we secure the user profile data. Then global software control and boundary conditions of our system are explained. After we make our system architecture properly, we can dive into the program in our system without any hesitation.

### 3.2 Subsystem Decomposition

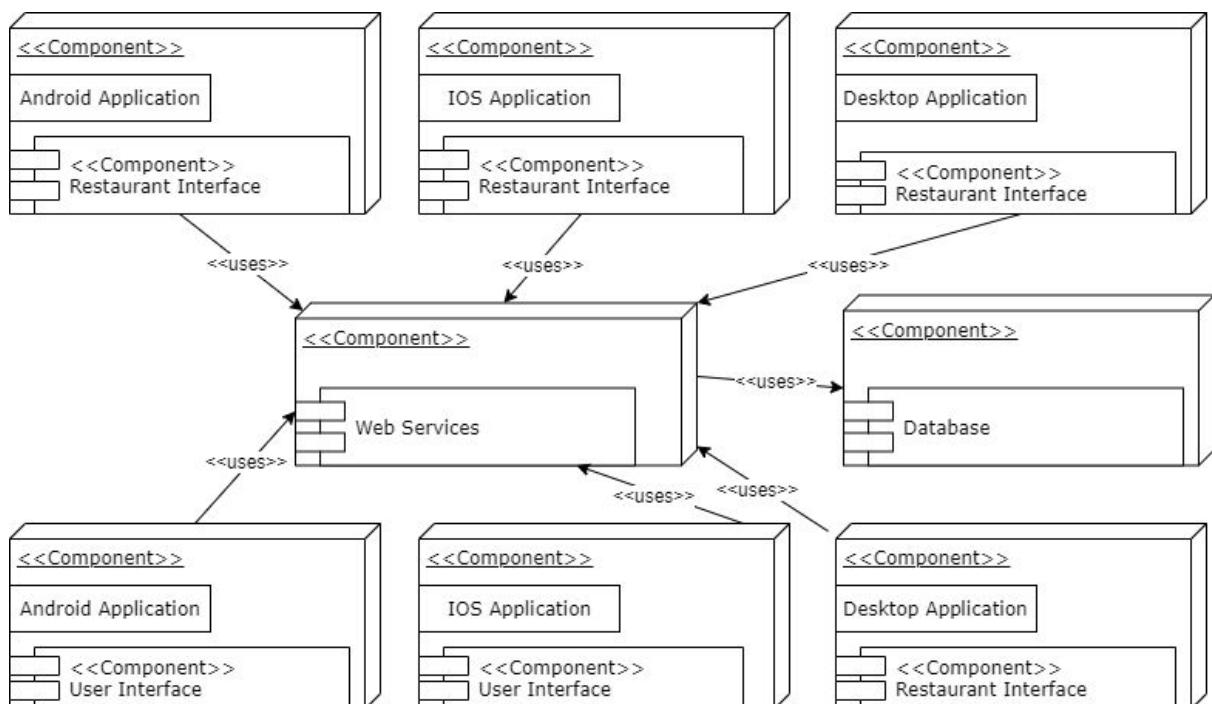


Figure 1: Component Diagram of Toproffer

#### IOS Application

IOS Application has two sub-components, user and restaurant owner interface. Components are implemented with the Flutter framework using Dart because of easy connection with WebService and higher compatibility.



## **Database Manager**

Database Manager Database Manager is the controller of the information that is collected in the database. Database stores user and restaurant information. Other than that it has information about the preferences made

## **Android Application**

Android Application has two sub-components, user and restaurant owner interface. Components are implemented with the Flutter framework using Dart because of easy connection with Webservice and higher compatibility.

## **Web Service**

Webservice provides the connection between application and server, database. When a user creates an account or when there is a campaign registered, it will be done with the help of the web service.

## **Desktop Application**

Desktop Application has two sub-components, user and restaurant owner interface. Components are implemented with the Node.js framework using Javascript because of high performance and easy scalability.

## **3.3 Hardware/Software Mapping**

Any user will send a request to web service, which is Google Firebase in our system, for authentication by any smartphone with Android or MacOS, and also by the Toproffer's website, then web service reaches the database and search if that user exists in our system or not. Also, when a user wants to benefit a campaign or restaurant owner wants to create a campaign, send the request to the web service and it updates the database according to the request.

Also, when a restaurant owner wants to benefit from our machine learning algorithm, they send a request to the Google Firebase, then Firebase interacts with our machine learning algorithm to train a model by using the data stored in the database.

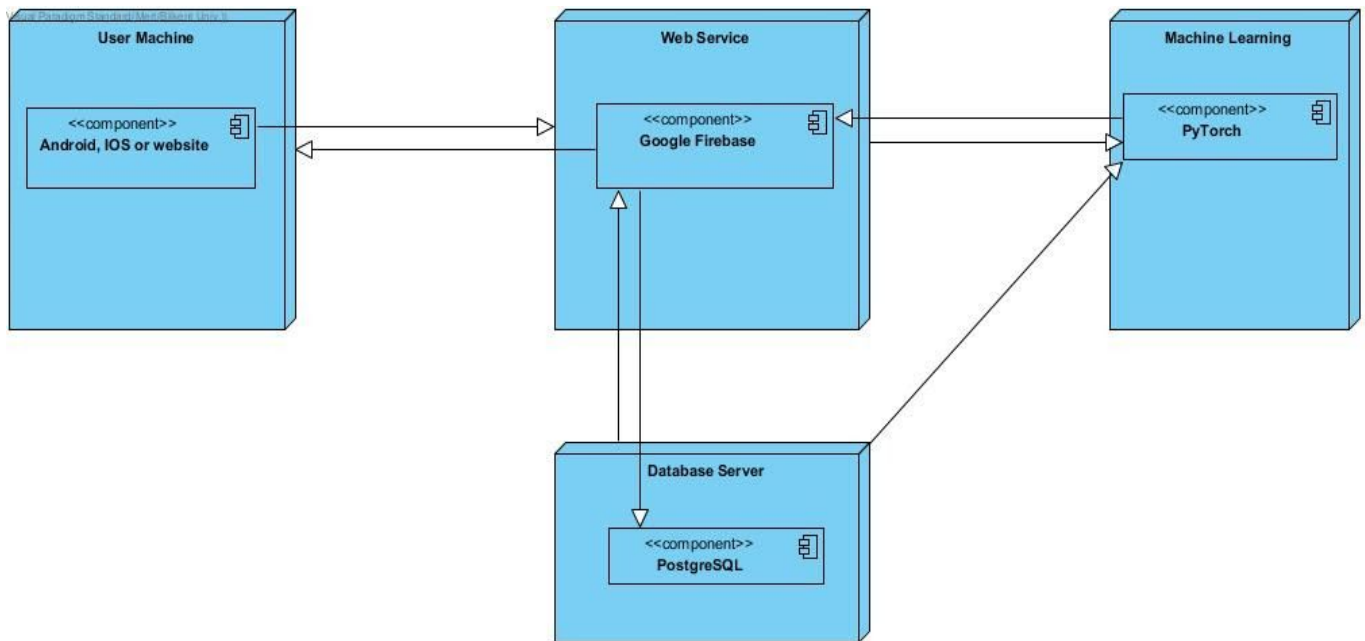


Figure 2: Hardware/Software Mapping of Toproffer

### 3.4 Persistent Data Management

In Toproffer, user information such as username, password, and e-mail will be stored in our database for later use. When a user signed up to Toproffer, his/her username, password, and e-mail are going to be saved in the database and when he/she is going to login to Toproffer this information is going to be checked during the user authentication process. After the user login to Toproffer, he/she can edit his/her profile by adding information about him/her such as name, surname, age, gender, etc. This information will be stored in Toproffer's database for future related operations. For example, to avoid showing a campaign containing alcohol to a user under 18.

When a restaurant owner login to Toproffer for the first time, to use Toproffer's "Campaign Generator" feature, he/she needs to enter the restaurant's menu to Toproffer. The menu of the restaurant is going to be saved in Toproffer's database. The information about campaigns that are created using Toproffer is going to be saved to Toproffer's database, too. This information is going to be used for Toproffer's "Campaign Generator" feature. Restaurant owners are going to enter the

data of the number of products that they sold in the day. This information is going to be saved to Toproffer's database and it is going to be used for Toproffer's "Campaign Generator" feature, too.

### **3.5 Access Control and Security**

We need to secure our user profiles after the authentication of our system. We will use the Google Firebase framework for all these authentication operations and this whole information is protected by Google. These informations cannot be gotten from other users for undesired purposes unless Google is hacked. So we are providing a very secure system using Google Firebase.

Also, due to we are storing whole data in the Firebase framework, all the data including the campaigns, restaurant owners and user's private information stored in the Google Firebase and they are secured by Google. Since the restaurants may give their all sold products if they want to benefit from our campaign recommendation feature, our database contains very private data for the restaurants and we are responsible to secure this database in order to secure all the private information of the restaurants. So we decided that the most reliable way of storing these data is storing them in the Google Firebase.

### **3.6 Global Software Control**

Since Toproffer runs on a web browser and mobile devices with IOS and Android operating system, Toproffer is going to use the server to manage all kinds of data. If a user has a mobile phone with a suitable operating system, when he/she make any operation, he/she sends a request to the database and Toproffer's system is going to reply user's request with a related reply. This process is going to occur with the help of Toproffer's server. For example, if a user edits his/her profile and presses the "Save" button, he/she sends a request to Toproffer's database with the help of our server and his/her profile information will be saved to the database. After that point, when he/she enters the application, this updated user information will be shown in the user's profile. A similar process is going to occur when the user, uses Toproffer via a web browser. When he/she sends a request to the server, the server is going to reply to the user's request with a related reply.

## **3.7 Boundary Conditions**

In this part, the boundary conditions are going to be explained such as initialization, termination and failure.

### **3.7.1 Initialization**

Toproffer has two types of users: customer and restaurant owner. While registering, the user needs to select the user type and he/she needs to fill the user information form. After the registration process is done, account verification mail is going to be sent to the user's e-mail address and the user is redirected to the login page. In the login page, the user needs to fill the username and password information, then he/she needs to press the login button. If the user entered a valid username and password, and if the username and password information matches the data in the database, the user will be logged in. Otherwise, the login process fails and the system shows the error message "Incorrect username or password!".

### **3.7.2 Termination**

After the user successfully logged in, he/she is going to be kept logged in. If the user closes Toproffer, the user's last state will be saved and when he/she opens Toproffer again, the last state will be loaded. If the user wants to log out, he/she needs to press the "Log Out" button and then the user logs out. This login and logout process is valid for both web browser and mobile version usage.

### **3.7.3 Failure**

Failures may occur while creating campaigns, editing user profiles, using campaign code, etc. In the case of failure, the user is automatically logged out and after he/she logs in again to Toproffer, our system is going to load the last successful state to the user. As a developer team of Toproffer, to inform us about the specific failure that users faced, Toproffer is going to send us information about failure.

## **4 Subsystem Services**

### **4.1 Database Manager**

In our system, one of the biggest problems we would face is a database management and fast interactions. Google Firebase provides us fast accessibility and real time changes on the database for updating the user interface. Transactions must be handled efficiently and securely for the sake of the system's stability and to preserve personal information. For this purpose, we are going to use a transaction manager. It is called Transaction Manager a service that Google Firebase provides. This service allows us to create a secure and stable connections to our database.

### **4.2 Campaign Manager**

When a restaurant owner creates a campaign, it should be visible on the map. For the perspective of business owners, restaurant owners may lose possible customers and if that happens the system's trustability will decrease. Therefore we will be updating the map through database changes in real time.

### **4.3 Login Manager**

Firebase Authentication provides backend services, easy-to-use SDKs, and ready-made UI libraries to authenticate users to your app. There are many ways potentially users may choose to go through, Google Firebase supports authentication using passwords, phone numbers, popular federated identity providers like Google, Facebook and Twitter, and more.

### **4.4 Map Manager**

Flutter will be used for the user interface. For managing the map, we will pull the locations on the map by using Google Map API. When a restaurant owner creates a campaign that information goes to the database and the location of the restaurant appears on the map. The campaign information is briefly shown on the map as well.

## **4.5 Campaign Generator**

We have machine learning for suggesting possible campaigns for restaurant owners. Our system searches and analyzes the products that are served by restaurants and based on that knowledge it suggests campaigns. If restaurant owners decide to go with those suggestions they may create those campaigns visible to the users. The problem we would face about that system is some restaurants may have different names for their products and the classification of those products will be important for our machine learning models. In addition, campaign manager has another important task to handle which is code matching. When a user wants to benefit from a campaign from a restaurant, user and the restaurant, mutual approval must be fulfilled. The user will receive a unique code and when restaurant receives that code, restaurant will be able to recognize whether the code is valid or not. If the code is proper, user can get the serviced campaign.

## **4.6 Notification Manager**

When a user registers to Toproffer for the very first time, there will be a set of questions asked user to understand what are the customer's interests. Then based on those interests, first notification will send to the user. Based on multiple constraints system will check the restaurants for the user and based on the classification check system will send users notifications from time to time.

## **4.7 Profile Manager**

Every person who uses application will have option to change, save and update his/her personal information in the application. For authentication especially, e-mail address is very important because the program will be distinguishing users type whether he is a restaurant owner or not based on the uniqueness. There can be only one account at a time with a unique e-mail address. If they would change their e-mail addresses and somehow because of a reason delete their old e-mail address, they will have to update their profile with the new e-mail addresses.

## 5. New Knowledge and Learning Strategies

We will use cross-platform technologies for the project and this is new to all of our group members. Flutter will be used for the frontend. We will learn the Dart language because Dart is a client-optimized programming language for apps on multiple platforms which is exactly what we need for our project. To work with Android and IOS we are looking for information through the internet. Flutter is very suitable for our project because of its unique rendering system. Unlike ReactNative and other platforms, Flutter uses its platform to render therefore whichever device is used, the screen which users interact with will be the same. Udemy, Course Hero, Lynda are the top three websites that are providing us with reliable information. At some point, we may need to consult with our teachers and professionals about their experience and expertise. We believe our innovation Expert Burcu Coşkun Şengül will help us with her guidance in the process of creating our project. In the very first beginning of learning new technologies, we will need to make practices and adapt ourselves to those technologies. When we become familiar and confident about the new technologies, then we will be able to use them for the implementation of our project. Currently, some of us are studying machine learning, some of us are practicing Flutter and Database technologies. For authentication in our project, we are planning to use passport js, and for the database system, MongoDB is analyzed and both of the systems are found suitable for this project. If we would write our database authentication system manually on a node js web server, in the long term that will decrease our scalability and maintainability thus effectiveness. When we considered these mentioned above, for this infrastructure, we planned to use google firebase in the end. Also when we considered that both flutter and google firebase created and managed by Google, their compatibility is high which will increase our efficiency at the implementation phase and after. Also, firebase provides us a realtime update on our system. For the machine learning training model, we are planning to use a neural network because it gives more accurate results on a big amount of data.

## 6. Glossary

**Algorithm:** a precise step-by-step plan for a computational procedure that begins with an input value and yields an output value in a finite number of steps

**Android:** Linux based operating system for mobile phones

**Authentication:** proof of the identity of a user logging on to some network

**Backup:** a copy of a file or record, stored separately from the original, that can be used to recover the original if it is destroyed or damaged

**Back-end:** that part of a hardware or software system that is farthest from the user

**Campaign code:** the code that is generated for each campaign in Toproffer

**Chart:** a graphical presentation of something

**Cross-platform:** This is best described as a standard that a computer system can be developed Operating systems such as Windows and DOS are examples of platforms that work on the PC platform only Likewise, MacOS can only be run on an Apple Mac computer When you have a "Cross-Platform" you are referring to hardware or software that can be used on BOTH PC's and Macintosh computers

**CSS:** Cascading Style Sheets

**DBS:** Database System

**Diagram:** a plan, drawing, sketch or outline to show how something works

**Deadline:** a date on or before which something must be completed

**Emulator:** a piece of software or hardware that simulates other hardware

**Encrypted:** describing something that is in code

**Error:** failure to complete a task

**Framework:** Library or some other piece of software that provides a skeleton for application

**Front-end:** that part of a hardware or software system that is closest to the user

**Hourglass:** a clock made of two glass vessels connected with a narrow passage, with sand flowing through that passage

**HTML:** HyperText Markup Language

**HTTPS:** Hypertext Transfer Protocol Secure, (HTTP Secure) an encrypted form of information transfer on the internet

**Inflation:** a decline in the value of money



**IOS:** the operating system of Apple smartphones

**KVKK:** the law that protects user's rights and protects their information in Turkey

**Machine learning:** a field concerned with the design and development of algorithms and techniques that allow computers to learn

**Node.js:** Node.js is a platform built on Chrome's JavaScript to build network applications.

**Optimization:** the design and operation of a system or process to make it as good as possible in some defined sense

**Mock-up:** to create a model or demonstration; to create a preliminary version or sample

**OS:** Operating System

**Pop-up:** a pop-up advertisement; an advertisement that is triggered to appear on a computer screen when an internet user accesses a particular web page

**Response time:** The period of time between a request for a service and the associated response

**Social network:** A network of personal or business contacts, especially as facilitated by social networking on the Internet

**Spam:** a collection of unsolicited bulk electronic messages

**SSL:** initialism of Secure Sockets Layer. cryptographic protocols which provide secure communications on the Internet

**SQL:** Structured Query Language

**User manual:** a guide for the person using the product, instructions

**UI:** User Interface

**UML:** Unified Modeling Language

**Verification link:** the link that is sent to the user to verify his/her email address

**Workflow:** a process and/or procedure in which tasks are completed. It may be defined with a flowchart to define actors, actions, results, decisions, and action paths

**Photoshop:** to digitally edit or alter a picture or photograph