



Department of Computer Engineering  
Bilkent University

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# Senior Design Project

*TechRank*

## Project Final Report

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Final Report  
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# 1. Introduction

Online shopping is one of the rapidly growing trends in the last decade. People think that doing shopping with using websites or shopping apps is easier and less time consuming than doing shopping in the stores. Because, they can search the products they want to buy by using search bar without losing time while finding the products in the store. Customers are surfing on e-commerce websites not only for buying the products online but also, even when people are buying things from stores, they are checking out reviews and comments of products online. In any case, checking out reviews is quite common nowadays, as it is hugely beneficial. However, people do not want to read hundreds of comments due to timing constraints. In addition, it is not always easy to understand general consensus on comments because there are inconsistencies among comments. Because of that, seeing the products' rates that are constituted by analyzing all comments is beneficial for the user. By observing rates about the products, customers can easily decide which product is worth buying. When we consider the common usage of online shopping, we decided to develop a web application in order to help people to decide and find out which technological product is beneficial and necessary for them by analyzing user comments from trusted e-commerce websites and by rating and ranking them into some related categories. Our application will analyze all comments scattered on web, then it will rank the devices on the same category using criteria. TechRank will also decide on overall rating for the device and overall rating for the producer company of the device

## 1.1. Purpose of the system

The purpose of this Project is to save people's time to read comments of product in the e-commerce shopping website and provide general view of customer satisfaction. Lots of people that are using e-commerce website faced with this problem. Our project helps people to decide and find out which technological product is beneficial and necessary for them by analyzing user comments from trusted e-commerce websites and by rating and ranking them into some related categories. Our application will analyze all comments scattered on web, then it will rank the devices on the same category using criteria. TechRank will also decide on overall rating for the device and overall rating for the producer company of the device.

## 2. Final Architecture and Design of the System

For TechRank, three-tier design pattern is chosen. The main working principle of the system of application is based on client-system. In this system a client side send a request by interacting with the interface, then server side responds this request according to desired data by request. The

main reason why three tier architecture is selected since, it supports the workflow in the client-server system while separating server side from the client side by limiting direct interactions between end user and database. Briefly three tier design is the only design pattern that provide sufficient features to system of TechRank. As it can be understood from its name, design choice of TechRank separates and classifies all of the system into 3 main components. Which are:

- Presentation Tier
- Logic Tier
- Data Tier

Each of these tiers has their own qualities and missions inside the system composition. The presentation layer is responsible for providing Graphical User Interface to the clients and listening any action that client is performing on this interface. This tier is also responsible for making REST calls according to the user actions on the front-end and sending HTTP commands to the related endpoint of the server by means of using request-related controller and service modules that define the request endpoints. Logic tier is responsible for listening for any action on the server by the use of predetermined endpoints. Controllers and services found in this subsystem are responsible for handling the logic behind the REST calls (such as converting RequestDTO's to Entity classes, navigating requests to related controllers and services in order to communicate with the database). Data tier is responsible for communicating with database and retrieving data required for logic tier to process and return back to the presentation tier. In this process, data tier uses repositories which communicate with databases using the request-related entities.

## 2.1. Presentation Tier

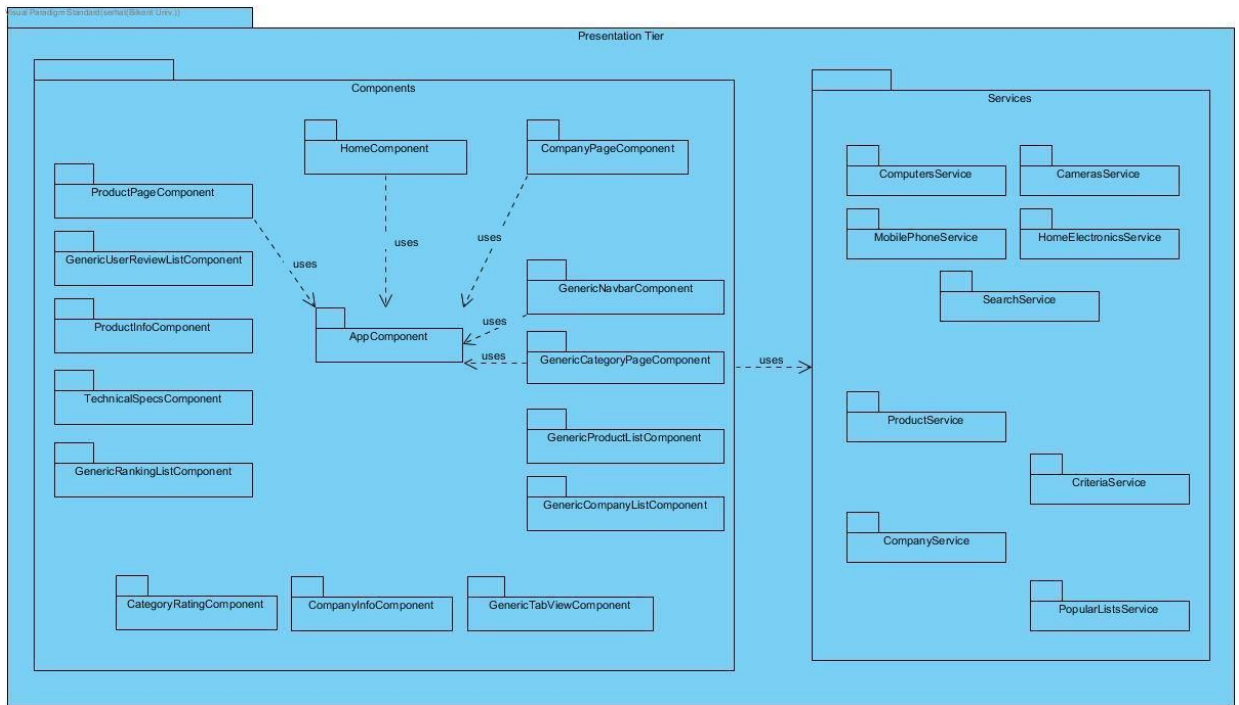


Figure 1 Presentation Tier Diagram

Generic components have multiple inheritance with the other component. because of heavy load on the diagram they are not shown on the diagram.

Presentation tier is responsible for managing interactions between the end-user and the user interface of the application

Logic tier is consist of 2 different parts which are:

- Components
- Services

### 2.1.1. Components

This package inside presentation tier includes HTML and CSS files that will be presented to the client. It also create a pattern for the design of front end.

**AppComponent:** AppComponent class is basically a design part of the TechRank web page which will be common for all of the pages inside the web application. It will contains web page header.

**HomeComponent:** HomeComponent is the class that is designed for UI design of the main (entering) page of the webpage. This component will contains popular ranking lists inside it which will be created by using other components.

**ProductPageComponent:** ProductPageComponent is responsible from design of the product pages. This component will contain all of the technicalSpecsComponent, ProductInfoComponent, GenericUserReviewListComponent, GenericRankingListComponents

**CompanyPageComponent:** CompanyPageComponent is responsible from design of the company pages. This component will contain CompanyInfoComponent and CategoryRatingComponent.

Other components are:

**GenericCategoryPageComponent**

**GenericTabViewComponent**

**GenericNavbarComponent**

**GenericProductListComponent**

**GenericCompanyListComponent**

**GenericUserReviewListComponent**

**GenericRankingListComponent**

**ProductInfoComponent**

**TechnicalSpecsComponent**

**CompanyInfoComponent**

**CategoryRatingComponent**

Note :detailed content of these components explained in third part of the report.

### 2.1.2. Services

**ProductService:** This module's functions are used by **ProductPageComponent** and all of other components that required product info from backend, in order to make REST calls to the server. It handles the product related endpoints and their communication with the server.

**CompanyService:** This module's functions are used by **CompanyPageComponent** in order to make REST calls to the server. It handles the company related endpoints and their communication with the server.

**PopularListService:** This module's functions are used by **HomeComponent** in order to make REST calls to the server. By using this class home component can reach all 4 popular list from backend. It handles the popular list related endpoints and their communication with the server.

**CriteriaService:** This module's functions are used by **most of the Components** in order to make

REST calls to the servers. It handles the criterion related endpoints and their communication with the server.

**ComputersService:** This module basically gets company and product list that belongs to this category from backend.

Note: Other Category Services that similar to ComputersService are not described in detail since their content is same with ComputersService.

Note: Search bar related endpoints and their RESTful services are handled inside all the components and services according to the type of the query passed by the client to the search-bar.

## 2.2 Logic Tier

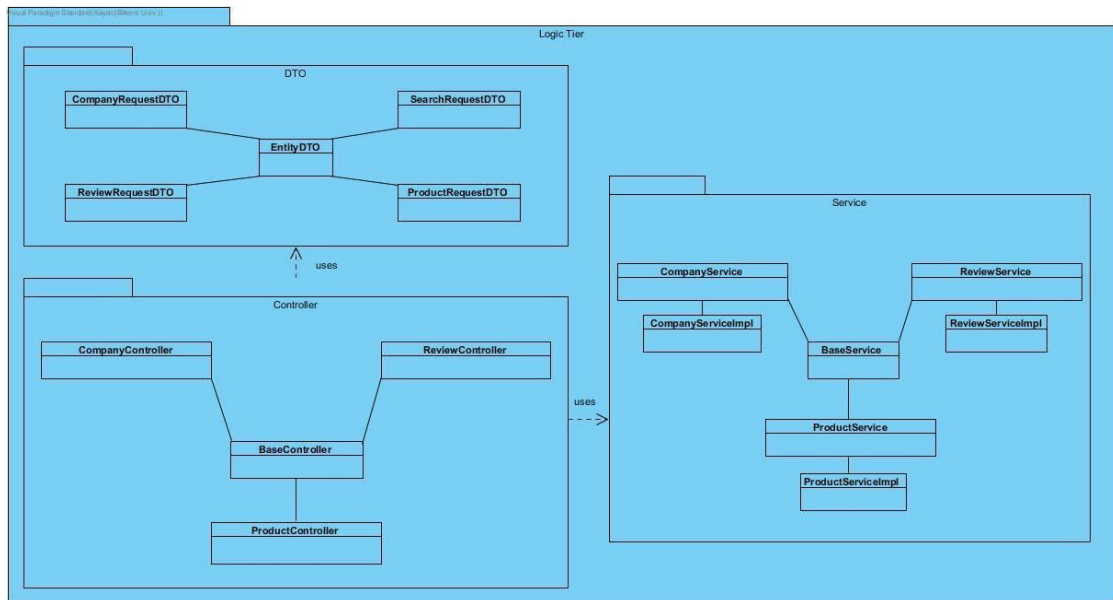


Figure 2 Logic Tier Diagram

Logic tier is consist of 3 different components which are:

- DTO
- Controller
- Service

### 2.2.1. DTO

**EntityDTO:** Base parent class that is responsible for holding information common to all the DTOs. DTO classes are used in the process of communication with the frontend. The server does not respond to the requests directly with the entity classes but with DTO classes to either encapsulate

the entity classes or limit the response messages from the server regarding security concerns. DTO classes reshape the entity classes and are then used by controllers while responding the request.

**CompanyRequestDTO:** This class is responsible for deciding what to return if a company-related request is detected.

**ReviewRequestDTO:** This class is responsible for deciding what to return if a review related request is detected.

**SearchRequestDTO:** This class is responsible for deciding what to return if search request is detected. It in most of the cases encapsulates list of objects to be used and returned back to client.

**ProductRequestDTO:** This class is responsible for deciding what to return if a produce related request is detected.

### 2.2.2. Controller

**CompanyController:** This class responsible for handling the REST request endpoints related to companies originating from the client. It uses CompanyService to get data (in Company type) and then convert it to CompanyDTO to respond to the request queried by the client.

**ReviewController:** This class responsible for handling the REST request endpoints related to user reviews (comments) originating from the client. It uses ReviewService to get data (in Review type) and then convert it to ReviewDTO to respond to the request queried by the client.

**ProductController:** This class responsible for handling the REST request endpoints related to products originating from the client. It uses ProductService to get data (in Product type) and then convert it to ProductDTO to respond to the request queried by the client.

### 2.2.3. Service

**CompanyService:** This interface is used by CompanyController which uses this class' methods for retrieving related information from the database.

**CompanyServiceImpl:** This class provides the implementation for CompanyService interface. This class uses CompanyRepository class to ask for the data in the database.

**ReviewService:** This interface is used by ReviewController which uses this class' methods for retrieving related information from the database.

**ReviewServiceImpl:** This class provides the implementation for ReviewService interface. This class uses ReviewRepository class to ask for the data in the database.

**ProductService:** This interface is used by ProductController which uses this class'



methods for retrieving related information from the database.

**ProductServiceImpl:** This class provides the implementation for ProductService interface. This class uses ProductRepository class to ask for the data in the database.

## 2.3 Data Tier

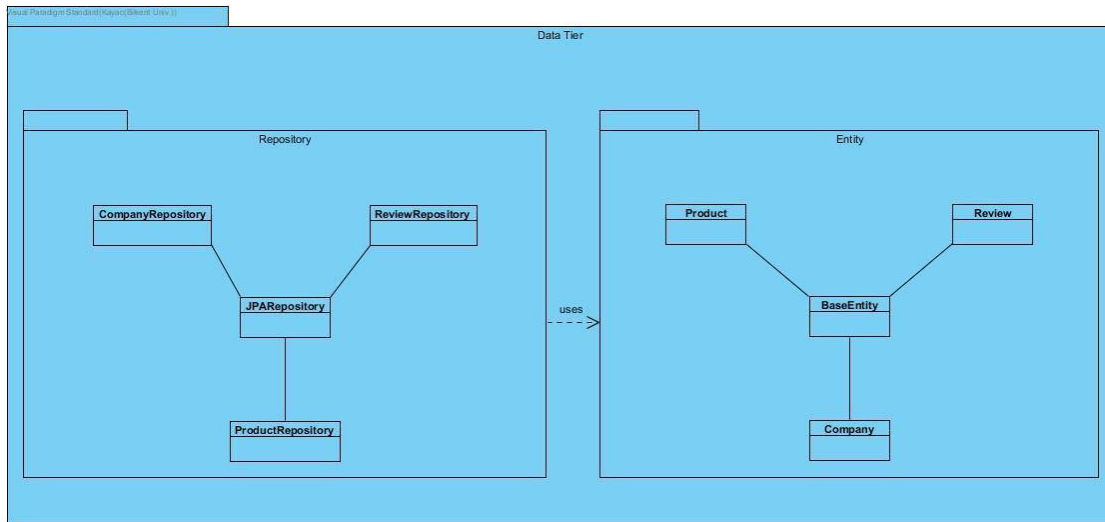


Figure 3 Data Tier Diagram

Data Tier consists of 2 different components which are:

- Repository
- Entity

### 2.3.1. Repository

**CompanyRepository:** This class is used by CompanyService, it returns back to it after retrieving data related to Company entity. This class extends JPARRepository interface (found in Spring Framework package) which provides wide range of interactive methods to retrieve data from the database.

**ReviewRepository:** This class is used by ReviewService, it returns back to it after retrieving data related to Review entity. This class extends JPARRepository interface (found in Spring Framework package) which provides wide range of interactive methods to retrieve data from the database.

**ProductRepository:** This class is used by ProductService, it returns back to it after retrieving data related to Product entity. This class extends JpaRepository interface (found in Spring Framework package) which provides wide range of interactive methods to retrieve data from the database.

### 2.3.2. Entity

**BaseEntity:** Base parent class of entity objects which holds common information that all the entities share. Custom entity classes below which extends this class will be used by related repositories while retrieving information from database.

**Product:** This class represents the Product entity which is basically a representative of an object retrieved from Product table.

**Review:** This class represents the Review entity which is basically a representative of an object retrieved from Retrieve table.

**Company:** This class represents the Company entity which is basically a representative of an object retrieved from Company table.

Note: Repository interfaces, by means of using JpaRepository interface, create a vast amount of methods related to the entity object that it is bound to so that complex queries can be handled.

### 3. Class Diagram

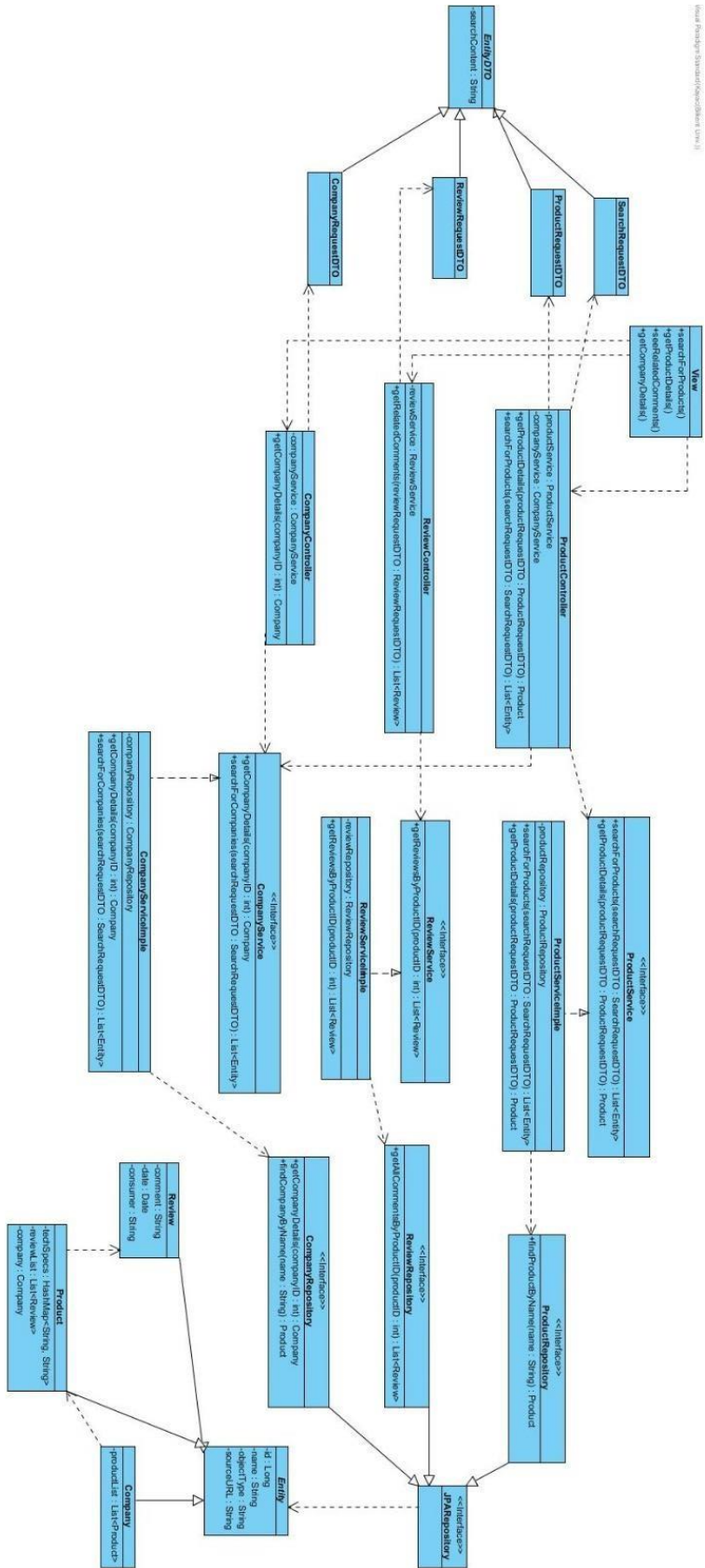


Figure 4 Class Diagram for TechRank

## **4. Impact of Engineering Solutions**

### **4.1 Global Impact**

Our application mainly focuses on to give general information, ranking and rating about the product in less time. People prefer our system instead of searching product in eBay, Amazon etc. due to saving their time when they are getting general information about product. In our system, we have large dataset which includes huge number of comments that are comes from trusted e-commerce websites. This also makes our system useful.

### **4.2. Economic Impact**

Our system has no economic impact. It can be used by individual people not by any company. Additionally, our system does not offer any user cost. Therefore, everyone can use it for free.

### **4.3. Societal Impact**

Since TechRank is a rating and ranking application which is based on shopping web sites, it directly affects people's shopping preferences. By giving information about products, TechRank helps people from all over the world to choose the product which is appropriate for user's requirements. Besides that, TechRank also can be used by advertisers in order to compare product. Therefore, they can easily and quickly select the product to advertisement.

## **5. Contemporary Issues**

Our data are written in English and foreign languages which are from most popular and reliable e-commercial websites. That's why, TechRank uses comments that are English and translated foreign languages. Additionally, there is no language selection feature in TechRank. Therefore, there will be an issue for people who do not know English language.

Each team member is responsible with the data and code which they used in the project. Retrieved data from e-commercial websites were used for academic purposes. As a team, we also do not generate any income from our software, so there can be no legal discussion.

## **6. New Tools and Technologies Used**

**Webstorm:** Webstorm is a javascript IDE developed by JetBrains. It can easily handle complex

server and client side development with Node.js.[1] In our case Angular cli project creation and development was very easy to go on with Webstrom. By means of its built-in terminal, the architecture components are easily constructed.

**IntelliJ IDEA:** IntelliJ IDEA is a special programming environment or integrated development environment (IDE) largely meant for Java. This environment is used especially for the development of programs. It is developed by a company called JetBrains, which was formally called IntelliJ.[2] For our project, Java Spring backend is developed and deployed by use of IntelliJ. It has plugins which makes configurations easy and the dependency management is done so easily with its gradle project capabilities.

**Angular:** Angular is an open source front end framework and it was **written** in Typescript. It was built by developers of Google.[3] In our project, we get opportunities that Angular 4-5-6-7 offers in its cumulative growth releases. By means of its component-wise architecture, frontend development was done in a very organized way.

**MySQL:** MySQL is an open source database for web-based applications, used high profile web properties.[4] The use cases of our project required a lot of relations between the entities, so that the benefits of MySQL relational database have been used.

**Git:** Git is a software that is used for Version Control. It is free and open source.[5] As it is a distributed version control system, we benefit from the opportunity that let us all to get separate copies of repositories.

**GitLab:** GitLab is a web-based DevOps lifecycle tool that provides a Git-repository manager providing wiki, issue-tracking and CI/CDpipeline<sup>[7]</sup> features, using an open-source license, developed by GitLab Inc.[6] Gitlab has issue boards in which we were able to follow the work done and burndown in a scrum way. It also gave us an opportunity to get private repositories for free.

**NLP(Natural Learning Processing):** Natural language processing (NLP) is a branch of artificial intelligence that helps computers understand, interpret and manipulate human language. NLP draws from many disciplines, including computer science and computational linguistics, in its pursuit to fill the gap between human communication and computer understanding.[7] As the analysis of language, we had an opportunity to tokenize and get the simple sentence structures of the corpus.

**Java Spring Framework:** Spring Framework is a Java platform that provides comprehensive

infrastructure support for developing Java applications. Spring handles the infrastructure so you can focus on your application. [8]. Java Spring enabled us to have a flexible code in the backend by means of integrating Hibernate, JPARepository to easily manage and configure database and backend server API.

**Pandas:** Pandas is an open source, BSD-licensed library providing high-performance, easy-to-use data structures and data analysis tools for the Python programming language. [9] It is used in the process of converting variable types to work on some machine learning algorithms.

**Sci-kit learn:** Scikit-learn is a free machine learning library for the Python programming language. Sc-kit learn models are used in our project, where we changed parameters of given models and methods to make them fit to our project. [10]

**NLTK (Natural Language Toolkit):** NLTK is a leading platform for building Python programs to work with human language data. [11] It is used in various places where we are dealing with modifying reviews which are all instance of human language data.

**PyMySQL:** *PyMySQL* is a pure-Python MySQL client library, based on PEP 249. Most public APIs are compatible with mysqlclient and MySQLdb. PyMySQL works with MySQL 5.5+ and MariaDB 5.5+. [12] PyMySQL is used in scripts that makes conversions from data scraped as MongoDB document to MySQL insert and update queries to insert them in our relational database.

**MongoDB:** MongoDB is a document database with the scalability and flexibility that you want with the querying and indexing that you need. [13] MongoDB is used to hold scraped data which are converted to MySQL indexes later.

**Selenium:** Selenium is a free (open source) automated testing suite for web applications across different browsers and platforms. [14] Selenium is used to automate browser to scrape the needed data from websites.

## **7. Appendix**

### **User Manual**

#### **System Overview**

TechRank saves people's time to read comments of product in the e-commerce shopping website and provide general view of customer satisfaction. TechRank helps people to decide and find out which technological product is beneficial and necessary for them. TechRank ranks the devices on the same category using criteria. TechRank will also decide on overall rating for the device and overall rating for the producer company of the device.

TechRank is currently available on web-browsers, such as Mozilla Firefox, Internet Explorer, Safari, and Google Chrome. TechRank is also compatible with mobile phones and can be accessed through the phone's web browser.

#### **System Configuration**

TechRank has platform support for all web browsers on desktop and mobile devices. It features one main screen for the app that can be accessed through the website. Users can search for the product by clicking the search button. They can see ratings and ratings of products and companies for different categories and also comments of the products

#### **User Access Levels**

All users can only view information but cannot directly add or edit new information to the system.

#### **Getting Started**

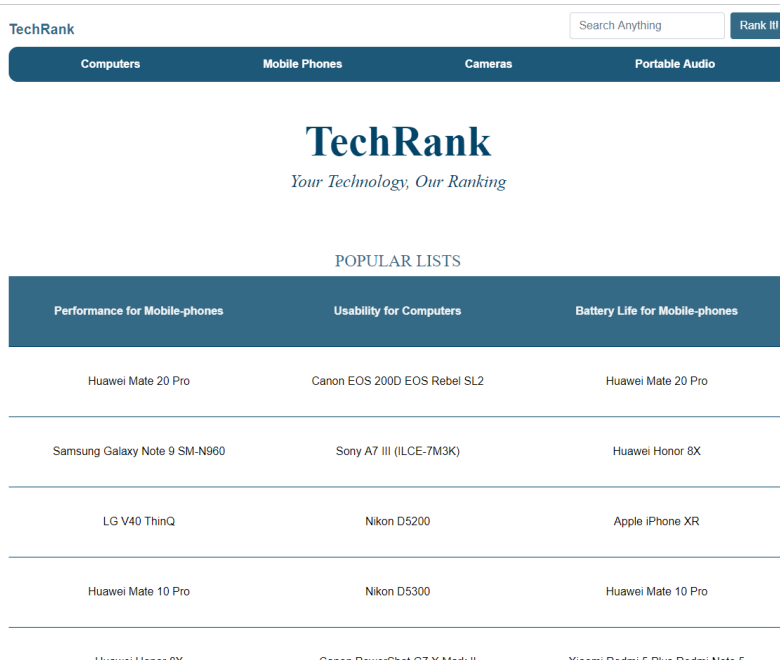
##### **Accessing the Page**

Our app is deployed on local server, so it starts with a source code.

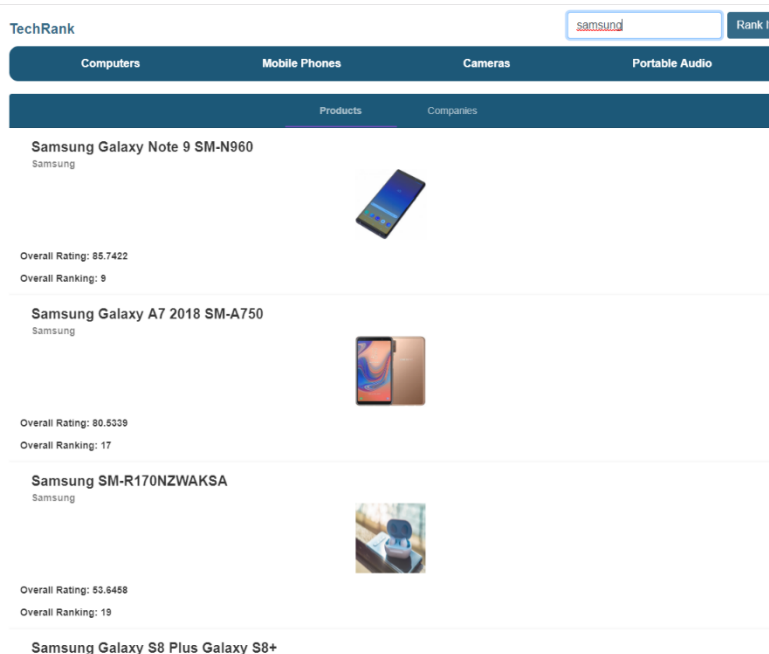
##### **System Menu**

##### **Searching a Product**

After a user has entered the website, he/she can see popular products list in the main page and the user can search a product or a company by typing it to the search text field and after clicks 'rank it' button.



Then, this page redirects user to the search result page.



User can see products' and companies' search result by clicking 'Product' and 'Companies'

## Accessing Categories


User can access the product categories by clicking 'Computers', 'Mobile Phones', 'Cameras', 'Televisions', 'Portable Audios'. User is redirected to that products' general page.





TechRank  Rank III


Computers Mobile Phones Cameras Portable Audio

Durability Performance Battery Life Usability

- 

**Huawei Mate 20 Pro**  
Huawei  
Rating: 98.3871 Ranking: 1
- 

**Samsung Galaxy Note 9 SM-N960**  
Samsung  
Rating: 94.9153 Ranking: 2
- 

**Huawei Honor 10**  
Huawei  
Rating: 94.4444 Ranking: 3
- 


**Apple iPhone XS Max**


From this page user can see the listed products according to ratings about that category by clicking 'Durability', 'Performance', 'Battery Life', and 'Usability'.


TechRank  Rank III


Computers Mobile Phones Cameras Portable Audio

Durability Performance **Battery Life** Usability

- 

**Huawei Mate 20 Pro**  
Huawei  
Rating: 95.4545 Ranking: 1
- 

**Huawei Honor 8X**  
Huawei  
Rating: 95.4023 Ranking: 2
- 

**Apple iPhone XR**  
Apple  
Rating: 93.7695 Ranking: 3
- 

**Huawei Mate 10 Pro**

## Accessing Product Page

User can access specific product's page by clicking into the product from the main page or search result page.

The screenshot shows the TechRank website interface. At the top, there is a search bar with the text 'samsung' and a 'Rank It!' button. Below the search bar is a navigation menu with categories: Computers, Mobile Phones, Cameras, and Portable Audio. The main content area features a product image of a Samsung Galaxy Note 9 SM-N960. To the right of the image, there are statistics for the product and the company Samsung. The statistics include Overall Rating and Overall Ranking for both. Below the statistics are four bar charts representing Durability, Performance, Battery Life, and Usability. The Durability chart shows a score of 94.9153%, Performance shows 95.1705%, Battery Life shows 91.7404%, and Usability shows 93.3735%. Below the statistics is a section for 'Technical Specification' with tabs for 'All Comments', 'Durability Ranking', and 'Durability Comments'. The 'All Comments' tab is selected, showing several user reviews. The first review states: 'One of the best product from Samsung.. No second opinions, just go for it.' The second review says: 'Samsung have done exceptional job on the note 9... Perfected almost every flaws that note 8 had... You cant say anything bad about the device even minor issues are not there to find... Speed and battery is improved heavily and it is just amazing....' The third review mentions: 'I have had my Note9 for a little over 2 weeks, I have tried all of the fixes recommended, which includes stopping the app and clearing the cache, deleting the cache partition and ultimately performing 3 factory resets... Does not freeze for about an hour, and then it all begins again.' The fourth review says: 'I have always been a die hard iPhone fan. I got tired of all the glitches with iPhone so I made the switch and I am so glad I did. I will admit it takes a few days to get use to but once you get the hang of this phone you will love it. I just wish they made cuter phone cases for them.' The fifth review states: 'Tried many things, disable power save function, disable wifi, disable data, disable bluetooth, disable app notification, still no luck. Considering returning the phone. Other than that, the phone is awesome. other than the fast charge is not that fast'.

In this page, user can see product's and company's overall rating and rankings and product's ranking according to categories. By clicking into categories user can see both all comments and comments that are related with that category and category ratings.

Durability: 94.9153% | Performance: 95.1705% | Battery Life: 91.7404% | Usability: 93.3735%

### Technical Specification

All Comments | Performance Ranking | Performance Comments

**Huawei Mate 20 Pro**  
Huawei

Overall Rating: 91.0156  
Overall Ranking: 2

**Samsung Galaxy Note 9 SM-N960**  
Samsung

Overall Rating: 85.7422  
Overall Ranking: 9

**LG V40 ThinQ**  
LG

Overall Rating: 86.3281  
Overall Ranking: 8

When criterion is selected, in the above case, performance, system gives the products on the same category with the currently viewed product ordered by the ratings on the selected criteria. User can select any product or company from this list and move to its page.

Overall Rating: 85.7422 | Overall Ranking: 9 | Overall Rating: 75.7086 | Overall Ranking: 10

Durability: 94.9153% | Performance: 95.1705% | Battery Life: 91.7404% | Usability: 93.3735%

### Technical Specification

All Comments | Performance Ranking | Performance Comments

Positive Performance Comments | Negative Performance Comments

minor issues are not there to find... Speed and battery is improved heavily and it is just amazing....

Absolutely amazing phone! Excellent battery plenty of memory. This phone is worth every cent with loads of features and at high quality for a fair price for what you're getting which is a lot. The blue back is beautiful.

I wanted to wait until I had the phone a couple of months before reviewing to put it through its paces. I have to say I am ecstatic at the performance of the Note 9. Not only is the Lilac colored phone beautiful to look at, it is fast, multitasking is a breeze, the battery lasts all day even with my...

I bought it some months back and it is one of the best phones I have used till date. Camera is of exceptional quality

I have had multiple Samsung Note phones and they have all been AMAZING. When I first got this phone back in November it was perfect- insane battery life, fast, responsive- flawless. After the PI update it has become glitchy, slow, with HORRIBLE battery life.

One of the best phones on the market And overall a good phone Face recognition is a bit slow as well as iris scanner Battery is not bad but it could be a bit better Exactly what you would expect from a note

I can confidently say that all the best craftspeople in the world came together to build this device. The response speed is out of this world. I love it. Though it came at a premium price, you'd agree with me that at a point in one's life, price became immaterial where a value is desired.


« « 1 2 3 ... 48 » »

User can also view positive and negative comments which holds information on selected criteria. This way user can see where our rating and ranking come from.

TechRank

Computers Mobile Phones Cameras Portable Audio

## Samsung




Company Ranking :10      Company Rating :75.7086

### CATEGORY RATINGS

| Category       | Percentage | Rank                         |
|----------------|------------|------------------------------|
| Portable-Audio | 53.6456%   | 13. company in this category |
| Mobile-phones  | 81.2243%   | 5. company in this category  |

Products      Company Ratings by Portable-Audio


**Samsung Galaxy Note 9 SM-N960**




Overall Rating: 85.7422  
Overall Ranking: 9

---

**Samsung Galaxy A7 2018 SM-A750**



User can also view page of companies where overall rating and ranking of the company is given. User can view all the products of the company and move to their page.




Company Ranking :10      Company Rating :75.7086

### CATEGORY RATINGS

| Category       | Percentage | Rank                         |
|----------------|------------|------------------------------|
| Portable-Audio | 53.6456%   | 13. company in this category |
| Mobile-phones  | 81.2243%   | 5. company in this category  |

Products      Company Ratings by Mobile-phones


**Apple**



Overall Rating: 84.773  
Overall Ranking: 3

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**Huawei**



Overall Rating: 87.3701  
Overall Ranking: 1

When selected a category that the company have products of, user can view list of all companies that compete in this category ordered by their ranking on this category.

## References

- [1] "What is WebStorm IDE?", Quora, 2018. [Online]. Available: <https://www.quora.com/What-is-WebStorm-IDE>. [Accessed: 02- May- 2019].
- [2] "IntelliJ Idea, Techopedia, 2018. [Online]. Available: <https://www.techopedia.com/definition/7755/intellij-idea>. [Accessed: 02- May- 2019].
- [3] "What exactly is Angular 2, Quora, 2018. [Online]. Available: <https://www.quora.com/What-exactly-is-Angular-2>. [Accessed: 02- May- 2019].
- [4] "About MySQL, MySQL, 2018. [Online]. Available: <https://www.mysql.com/about/>. [Accessed: 02- May- 2019].
- [5] "What is Git and why should I use it, Quora, 2018. [Online]. Available: <https://www.quora.com/What-is-Git-and-why-should-I-use-it>. [Accessed: 02- May- 2019].
- [6] "Gitlab, Wikipedia, 2018. [Online]. Available: <https://en.wikipedia.org/wiki/GitLab>. [Accessed: 02- May- 2019].
- [7] "What is natural language processing nlp, Sas, 2018. [Online]. Available: [https://www.sas.com/en\\_us/insights/analytics/what-is-natural-language-processing-nlp.html#nlp-how-it-works](https://www.sas.com/en_us/insights/analytics/what-is-natural-language-processing-nlp.html#nlp-how-it-works). [Accessed: 02- May- 2019].
- [8] *Introduction to Spring Framework*. [Online]. Available: <https://docs.spring.io/spring/docs/3.1.x/spring-framework-reference/html/overview.html>. [Accessed: 09-May-2019].
- [9] "Python Data Analysis Library¶," *pandas*. [Online]. Available: <https://pandas.pydata.org/>. [Accessed: 09-May-2019].
- [10] "Scikit-learn," *Wikipedia*, 05-May-2019. [Online]. Available: <https://en.wikipedia.org/wiki/Scikit-learn>. [Accessed: 09-May-2019].
- [11] "Natural Language Toolkit¶," *Natural Language Toolkit - NLTK 3.4.1 documentation*. [Online]. Available: <https://www.nltk.org/>. [Accessed: 09-May-2019].
- [12] J. Bodnar, "PyMySQL tutorial," *PyMySQL tutorial - Python MySQL programming with PyMySQL module*. [Online]. Available: <http://zetcode.com/python/pymysql/>. [Accessed: 09-May-2019].
- [13] "What Is MongoDB?," *MongoDB*. [Online]. Available: <https://www.mongodb.com/what-is-mongodb>. [Accessed: 09-May-2019].
- [14] "What is Selenium? Introduction to Selenium Automation Testing," *Meet Guru99 - Free Training Tutorials & Video for IT Courses*. [Online]. Available: <https://www.guru99.com/introduction-to-selenium.html>. [Accessed: 09-May-2019].