Literature Review

Scavenger Hunt Game Using BLE Beacon

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Abstract

In this project, we will develop a mobile “Scavenger Hunt” game which will be a service-based web application built on top of this application for BLE Beacons, that makes it possible to do all your configurations of the application on the web. This game will be a fun game where several teams earn points by doing the jobs in the task list which is given to them and try to get the highest points by doing the jobs that specified in the city, campus or a certain area. The fundamental idea of this scavenger hunt game type is that you can see the locations on the map by following specific rules. Players can make appear the locations as game creator wants and questions pop up when a player is at the right position. The main purpose of this project is to make easier to perform the missions which is expected from people with an entertaining way [1].

1 GAMIFICATION

Gamification can be defined as the use of game design elements in non-game applications. It is the process of integrating game mechanics and game dynamics into a website, service, online platform or content portal to ensure participation and engagement [2].

1.1 What is Gamification?

Gamification means applying gaming philosophy and game-based thinking to non-game activities in order to change the tendencies and behaviours of people. The main goal of this method is combining work with fun to encourage people and increase their participation and motivation [3]. For example, gamification can be used to increase the participation in a business activity, to increase the frequency of use of a service or a website, to encourage people to share more on their platforms where they are registered, or identify active users in a platform.

1.2 Game Mechanics and Game Dynamics

Game mechanics are the fundamental actions, behaviours, processes and control mechanisms that are used to gamify an activity. They are the rules and techniques that taken together to create a compelling and engaging user experience. They make the activity challenging, fun, satisfying, or any other emotion that designers of game want to remind users [4]. Using them individually or together generates highly motivational users. These game mechanics are:

- Points
- Levels
- Challenges, Trophies, Badges, Achievements

- Leader boards [5]

On the other hand, game dynamics are the reasons why people are motivated by game dynamics. The emotions that are reminded to users by game mechanics are called as dame dynamics. Game dynamics are people's desires, motivations and needs of the game experience. Some of the game dynamics are:

- Reward
- Status
- Achievement
- Self-expression
- Competition
- Altruism [5]

1.3 History of Gamification

Using play and fun to motivate people and make work life more entertaining is in our lives for a long time. According to known, the use of gamification started in 1912 but the term gamification is added to our vocabulary recently. Even before this term entered into our lives, many researchers were already exploring the role of fun and play in computer-based applications. In 1980s, publications that are related to Gamification were released by Thomas W. Malone which are "What Make Things Fun to Learn" and "Heuristics for Designing Enjoyable User Interfaces: Lessons from Computer Games". In 1990s, Stephen W. Draper published Analyzing Fun as a Candidate Software Requirement [6].

In the early 2000s, the role of fun and play in user experience is became a more considered tool by people. The idea behind this use of playfulness in software was that instead of just making simply usable interfaces, they could be fun to use as well. Therefore, to enhance the experience that the user had with the software, designers chose to consider how positive emotions and good feelings could be ensured through things such as sounds, graphics and challenges [7]. After this, applications that directly used elements from games have appeared. In 2007, Chore Wars which is a task management application with a role playing game with experience points and monster battles has released [6]. Then, Bunchball which is a gamification tool for enterprises was introduced. Bunchball launched the Nitro platform which allows organizations to integrate game mechanics into social networks, mobile applications and websites [7]. In 2009, Foursquare which is

a highly successful and popular application was released. It is a location sharing social network application that gives points and badges to users for using its “check-in” service to indicate their locations. In 2010, gamification became more popular and the term adopted by companies such as Bunchball and Badgeville to represent the platforms they had created to integrate game elements into websites [6]. In 2011, the first Gamification Summit held in San Francisco [7].

Since 2011, gamification gained much more attention in both industry and academic world and growing rapidly. Conferences are organizing, books and articles are publishing about gamification. In time, more and more organizations started to use gamification in many different areas.

1.4 Examples of Gamification

1.4.1 Amazon.com

Reviews in online websites are very significant for customers because other customer’s opinions have a big influence on the decision of buying the products. Both the quality and the quantity of reviews are important. Writing a comprehensive review can be difficult. That’s why, some comments are so much more beneficial and useful than others [8].

In order to improve both the quality and the quantity of reviews Amazon.com started the Amazon’s Top Reviewers program which rewards customers for their helpful reviews. Customers vote the reviews of other customers to indicate if that review was helpful for them or not by choosing yes or no. The number of helpful reviews of a customer turns into points. To increase the competition, there is a leader board which shows the rank of reviewers [8].

1.4.2 Prezi

Prezi is a popular presentation software like Microsoft PowerPoint. It is a web-based tool for creating innovative and original presentations. This service works in the online platform and it offers a totally new and different way of presenting such as zooming to pictures and using one big picture instead of regular slides. Its unique features are the reasons why people choose Prezi against Microsoft PowerPoint which its big competitor [8].

Prezi targeted students which are the professionals of tomorrow to get the general public to use Prezi instead of Microsoft PowerPoint. Because, if they are using Prezi now, they might continue to use it in the future. To reach students, Prezi has started the Prezi Ambassador Program [8]. The

Prezi Ambassador Program is an exclusive opportunity for fully matriculated university students around the world to gain valuable start up experience of their own [9]. Students from all over the world can apply for the Prezi Ambassador position of their university. There can be only one Ambassador in each university. The mission of the Ambassador is to prepare a plan to make Prezi popular in their university. To arrange activities like making presentations for other students will earn points, status and Prezi merchandise to Ambassador. Ambassadors from all over the world compete against each other for big prizes such as a trip to Prezi offices in Budapest or San Francisco. Prezi uses some of the key game elements in this program such as points, status and leader boards. In this way, Prezi uses gamification in its Ambassador Program to get new users from all over the world [8].

2 ANDROID

2.1 What is Android?

Android is an operating system which is designed for mobile devices and it is working on UNIX kernel. It is an open source and free to use. It was developed by the Open Handset Alliance, led by Google, and other companies. It has a quite comprehensive software architecture [10].

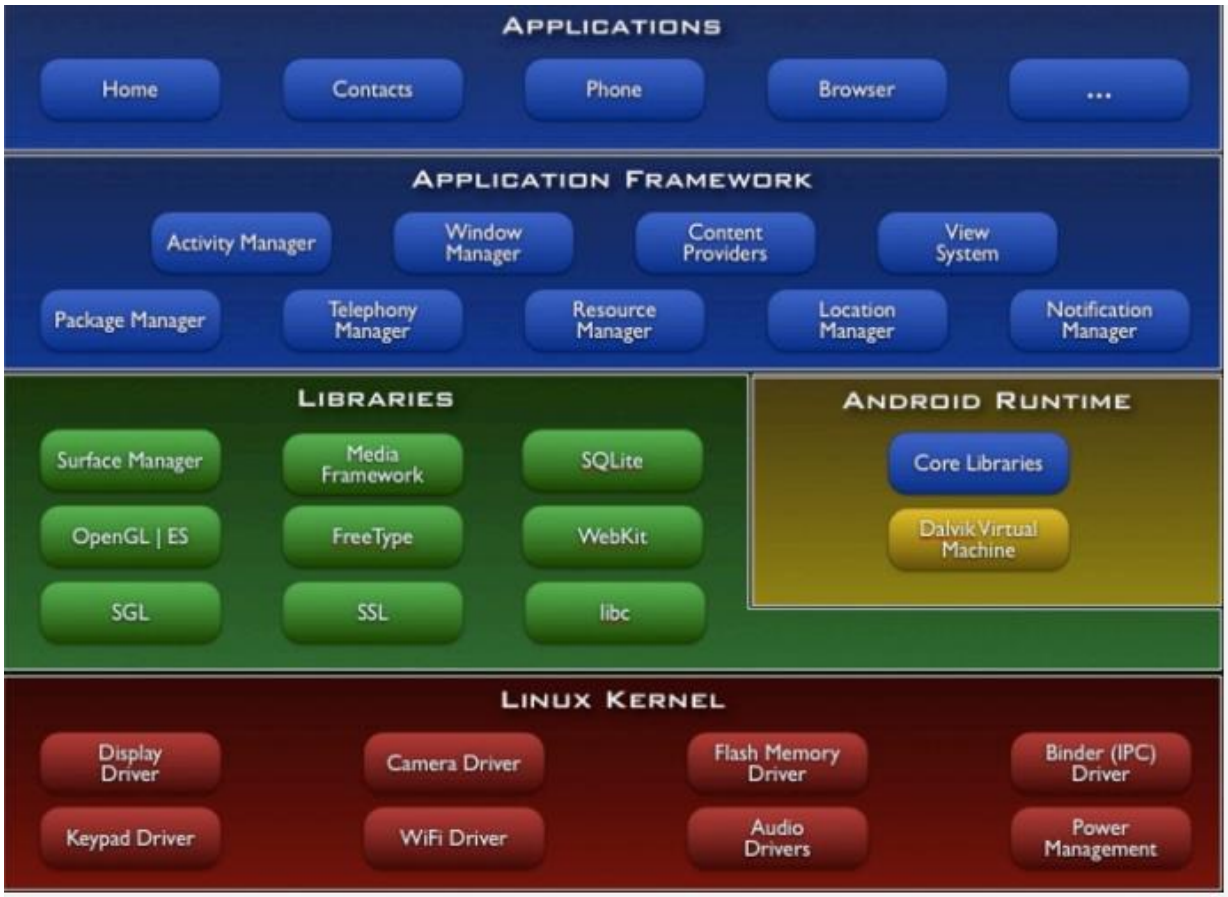

Figure 1 The architecture of android operating system [11]

Android has all necessary substructures and a large library for software developers. Previously, for the development of an application for mobile devices, developers handled the complex C and C++ codes which can change according to the device's processor, but thanks to evolution of mobile operating systems hardware access provided successfully by the developers. In this way, information of the hardware that works on a mobile device is not a necessity to access and control the hardware's component with Software Development Kit (SDK) [12].

2.2 Common Applications which Comes with Android

When you buy an Android cell phone, you will have some applications like web browser, music player, camera application, and mail manager. These are just a few of these applications. In addition, mobile device manufacturers provide their own applications. For example, for HTC phones, there is an interface library that coding on Android OS and its name is HTC sense. This is the special part of an Android OS. It does not depend on one shape of usage way. Different manufacturers are free to produce their own usage way. This is the purpose of establishing the Open Handset Alliance (OHA) [12].

With Android SDK, developers can do location-based operations, database operations with SQLite database, graphic operations like 2D or 3D game development, sensor and camera operations or background operations like automatic answer system to SMS.

2.3 Android Development Environments

There are several environments to develop android applications such as eclipse, Intellij IDEA and Android Studio. They help us to develop Android applications. Generally, we can represent the differences between Android Studio and others as shown in below:

- With Android Studio, we can develop applications for all Android devices and environments (phone, TV ...),
- Advanced compilation method with Grandle,
- Android application templates,
- With assistant tool, direct access to Firebase in editor,
- Android Emulator support,
- Advanced interface develop editor,
- With Expresso Test Recorder, Advanced test management [10].

And there is more features like these. That is why we decided to develop our project on the Android Studio.

3 WEB SERVICES

Web Services are the devices that communicate over the World Wide Web. When you use a mobile application, search engine or an enterprise system, application's interface resides on your device, but the data, and potentially the business rules resides on some other server on the network [13]. The communication between interface and application's server is the role of Web services. There are several platforms to do this communication such as PHP servers, WCF and Firebase.

3.1 PHP

PHP is a web-based, object oriented programming language. PHP is used to develop static websites, dynamic websites or web applications also it is an HTML-embedded web scripting language. This means PHP code can be inserted into the HTML of a web page. The goal of this language is to allow web developers to write dynamically generated pages quickly and easily. PHP is also great for creating database-driven websites [14].

3.2 WCF

Windows Communication Foundation (WCF) is a technology for developing applications based on service-oriented architecture. WCF is Microsoft's programming model for using managed code to build unified Web services and other distributed systems that can talk to each other. WCF is designed to communicate with other non-WCF applications in addition to the various successors and predecessors of Microsoft technology [15].

3.3 Firebase

Firebase is a Backend as a Service. It can be called as a real-time database. With using the API which is given by firebase, the developers can develop applications quicker and Firebase is developed with mobile development in mind, but it is absolutely not limited to mobile apps. Also, Firebase includes an easy to use hosting service for all of static files [16].

If you have a project that is developed on multiple platforms and if there is user entries and data storage in this project, Firebase is very useful. The general structure of Firebase is showed in Figure 2.

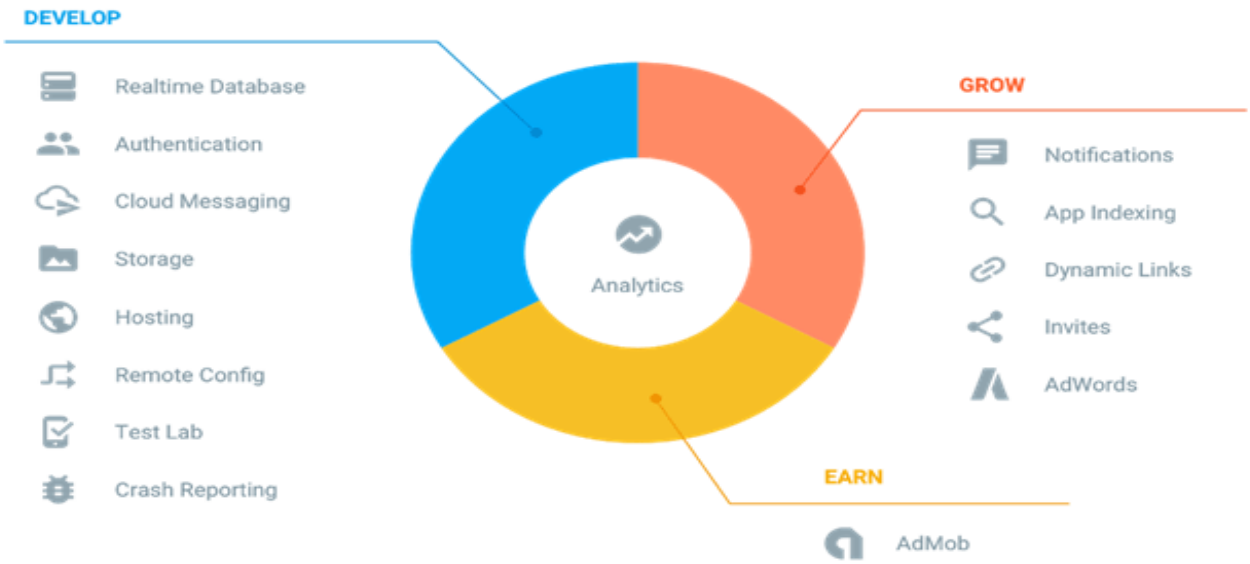

Figure 2 Firebase's general structure [17]

3.3.1 Database

Firebase provides a real-time NoSQL database service to users with this service. Normally, you have to set up a database in the web environment or on the mobile to perform database operations. According to the application, you have created services to reach the database, but thanks to Firebase's database service you can include a database in a program and use it easily.

3.3.2 Storage

With this service, you can store files such as pictures and text on your computers or servers. Users can download these files at any time.

3.3.3 Notification

If you want to communicate with users instantly in mobile applications that you created, you can send push notifications to users instantly with the notification service.

3.3.4 Firebase Analytics

With this structure, you can instantly see a lot of information, including the number of active users, the daily interaction of users, the models of users of your devices, the operating systems of the users. It is one of the most used services of Firebase [18].

3.3.5 Main Features of Google Firebase

- Real-time database
- User login authorization
- Storage
- Machine Learning Kits
- Performance and error testing environments
- Inter-platform common application analysis
- Common function
- Bulk notification
- Advertising tools [19]

Many of these features need to be handled individually on each platform, while developers can easily find a solution with Google's Firebase.

In our project, we decided to use Firebase, because it has more advantages compare to others and we think Firebase is fit in to our project.

4 BLE BEACON

4.1 What is BLE Beacon?

First, if you need to define this technology, Beacon is a technology that provides location information using low energy Bluetooth (BLE) technology. In other words, products or devices with Beacon technology can emit passive signals to interact with smart phones near them. Depending on the distance, this technology reaches people and then transmits the information they want to interact with [20].

4.2 How does BLE Beacon Work?

Beacons transmit small amounts of data through Bluetooth Low Energy (BLE) up to 50-70 meters. They are often used as indoor location technology and can also be used outside. Beacons are usually used with small batteries, but can be plugged into a wall outlet or USB port to provide

consistent power. In addition to independent beacon devices, mobile phones, tablets and computers with BLE support can both emit and receive Beacon signals and function as Beacons [21].

4.3 What does BLE Beacon Look Like?

Beacons are small and simple devices. If you turn someone on, you cannot see multiple motherboard or cable clutter; you will probably find CPU, radio transmitter and battery. Beacons often use CR2477-derived lithium-ion chip batteries. Beacons may be in different colors or shapes; they may have an accelerometer, temperature sensor or special additional components. Still, the common feature of all Beacons is to broadcast signals [22].

4.4 How does BLE Beacon Communicate?

The Beacon emits an identification number ten times per second. A nearby Bluetooth enabled device receives this signal. When an application recognizes its signal, it connects it to an action or content track stored in the cloud and allows the user to view it. By editing the application on your phone, you can set how it reacts to signals [23].

4.5 When did BLE Beacon Appear?

Today's Beacons appeared with Apple's announcement of iBeacon in 2013, and in 2015 Google entered the market with Eddy Stone. Since then, these two product groups have been leading the market [22].

4.6 BLE Beacon Usage Areas

4.6.1 Monitoring

Manufacturing and transport are practical areas of Beacon. Managers want to know exactly where the products are in the factory and when they are delivered. With the help of the Beacon network, they can obtain exactly what they want and access the archive of this information [23].

4.6.2 Navigation

Google Maps and other map providers serve for external areas. Clear instructions can be taken with Beacon in the closed areas. For example, the Louvre Museum covers an area of 60,600 m^2. It is very difficult to reach the artwork that is desired to be seen in such great museums without getting lost [23].

4.6.3 Interaction

Beacons can automate responses and trigger events. When you enter the room, the projection device starts to operate. Every time you go to the café, you pay nine and when you go to the vault for the tenth time, the app lets you know you have won a free latte [23].

4.6.4 Security

Beacon can automatically send a safety issue notice (to app users or property owners) when patients enter the wrong wings or make factory workers dangerous changes [23].

4.6.5 Analysis

Data is one of the largest tools in the hands of a company. Beacons can collect information about where the customers are going or where there are problems in the production line. This information can be stored and accessed on how users interact with the Beacon via the online platform [23].

5 RELATED APPLICATIONS WITH BLE BEACON

5.1 “Beacon Me” Mobile Application Help the Travelers as Tour Guide with Using Emojis

Modern cities are home to many attractions that may interest people. But travelers need robust mobile applications with user-friendly interfaces to help them find their way easily to discover every corner of the modern city where there are dozens of points to visit.

The Beacon Me mobile app is a mobile application designed to answer exactly this need. But it does this in an interesting way: using emojis to better help travelers discover new cities! It displays the activities, places to visit, restaurants, places and more on a map full of emojis. It is possible to find an emoji for almost all events and venues as the new emojis are used by phone and Internet users every day. The Beacon Me mobile app, which makes it easy for travelers to find points of interest, also gives travelers the opportunity to experience unique experiences that they will never enjoy in any other way.

In app or tasks users are available to users as an idea based on tasks that make them feel like a native of their city as they explore and complement attractions. The Beacon Me mobile app is now available for download from the App Store for the iOS operating system. Although the practice is

currently only available for Philadelphia, the creators of the application say they plan to launch the application in more cities soon [24].

5.2 Beacon and the Internet of Things are Changing the Banking Sector

When you enter the bank branch, the mobile banking application on your smart device and the sensors will tell you that you are there and will notify you of the sequence number. So, you do not have to dial the kiosks and get a number on paper. Or you will be able to receive special campaigns from your phone instantly within the context of your permission and needs within and around the bank branch. For transactions, starting from the mobile application, you will be able to receive notifications at the branch and save time by making your transaction on the phone. The sensors installed at ATMs will understand that you are approaching, and it will be able to communicate with you when you are at the ATM, and you will be able to withdraw money quickly in seconds without having to deal with the minutes in the ATM [25].

5.3 Chrome Android App Comes with Beacon Support

According to the Google Chromium blog, Android users will be able to interact with the Beacons soon via the Chrome browser. The new feature will be implemented in the 49th test version of Chrome for Android. With Bluetooth-based Beacons at any point, users will be able to exchange data between their phones. Emphasizing the importance of this new interaction platform called Physical Web (Google). Google first handled this work in July last year. Google has begun testing the Beacon interaction in Chrome for iOS and unveiling its work in CES 2016. With the increase of Beacon manufacturers and developers, it is finally the expected step for Android.

It is of course long to sort out what can be done with the Beacon interaction. However, details such as interoperability and user privacy are not fully resolved. We do not yet know what cyber attackers can do in this area, but the work in this area will progress continuously.

Google is organizing a competition in objects, and it is clear that the future will expand its work under the physical web tag. If you are interested in these issues, you should follow the Chrome updates for Android closely [26].

5.4 iBeacon Scavenger Hunt Application for iOS

With the iBeacon Scavenger Hunt you can set your own exclusive scavenger hunt game for iOS and Android devices. You can create a game by placing iBeacons in target locations and configuring their descriptors with the app. You can create a custom application based on the open source examples for Android and iOS, or use the developer's own apps in app stores. Scavenger hunts are great team building activities. They are perfect for encouraging people to visit long distance areas in trade fairs, meetings and conferences. The application is based on the developer's Proximity Kit for iBeacons cloud service, which allows you to make the iBeacon configuration in the cloud. This configurability is what makes it possible to create different Beacon Scavenger Hunts with the same application [27].

References

1. CENG 407 – 408 Project Proposal Form of Scavenger Hunt Game Using BLE Beacon by MuratSaran. Retrieved Retrieved November 5, 2018 from https://drive.google.com/file/d/1yY1N1bPedmuVGTtqSsUjW-8as2U1p8_u/view
2. Bunchball, I. (2010). Gamification 101: An introduction to the use of game dynamics to influence behavior. *White paper, 9*. Retrieved October 22, 2018 from http://jndglobal.com/wp-content/uploads/2011/05/gamification1011.pdf
3. Bozkurt, A., & Kumtepe, E. G. (2014). Oyunlaştırma, Oyun Felsefesi ve Eğitim: Gamification. Retrieved October 25, 2018 from https://ab.org.tr/ab14/bildiri/233.pdf
4. Bunchball, I. (2016). Gamification 101: An introduction to game dynamics. Retrieved October 25, 2018 from https://www.healthstream.com/docs/default-source/default-document-library/white-paper--bunchball-gamification.pdf?sfvrsn=2
5. Beza, O. (2011). Gamification - How games can level up our everyday life?. *VU University, Amsterdam*. Retrieved October 22, 2018 from https://www.cs.vu.nl/~eliens/ct/local/material/gamification.pdf
6. Fitz-Walter, Z. (2018). Introduction to Gamification. Retrieved October 25, 2018 from https://static1.squarespace.com/static/5993a36d6b8f5b8a32da7319/t/5b3a9fc6758d46456032f101/1530568702188/Introduction+to+gamification+1.02.pdf
7. Fitz-Walter, Z. (2013). A brief history of gamification. Retrieved November 2, 2018 from https://zacfitzwalter.com/articles/2017/10/7/a-brief-history-of-gamification

8. Van Den Boer, P. (2011). Introduction to gamification. Retrieved October 22, 2018 from https://cdu.edu.au/olt/ltresources/downloads/whitepaper-introductiontogamification-130726103056-phpapp02.pdf
9. Prezi. (2018). Prezi Student Ambassador Program. Retrieved November 5, 2018 from https://prezi.com/ambassadors/
10. Uslu, B. (2017). Android Tabanlı Mobil Uygulama Geliştirme, 5th edition. İstanbul: Kodlab.
11. Turkcell (2016, May 5). Android mimarisi ve özellikleri. Retrieved October 26, 2018 fromhttps://gelecegiyazanlar.turkcell.com.tr/konu/android/egitim/android-201/android-mimarisi-ve-sistem-ozellikleri
12. Narman, A. E. (2017). Android Studio ile Programlama, 14th edition. İstanbul: Kodlab.
13. Demircan, M. (2017). WEB SERVİSLERİ, SOAP, UDDI, WSDL Nedir?. Retrieved October 26, 2018 fromhttp://www.dmyazilim.com/bloglar/9/web-servisleri-soap-uddi-wsdl-nedir
14. Duymaz, G. (2017). PHP nedir?. Retrieved October 28, 2018 from https://www.mediaclick.com.tr/blog/php-nedir
15. Cesur, K. (2013). WCF nedir?. Retrieved October 28, 2018 from http://www.kazimcesur.com/wcf/
16. Neslihan. (2017). FireBase nedir, ne işe yarar, neden kullanmalıyız?. Retrieved October 28, 2018 from http://univera-ng.blogspot.com/2017/04/firebase-nedir-ne-ise-yarar-neden.html
17. Hackernoon. (2017). Introduction to Firebase. Retrieved October 28, 2018 from https://hackernoon.com/introduction-to-firebase-218a23186cd7
18. Uçarsu, O. (2017). Web ve Mobil uygulamalar için Firebase. Retrieved October 28, 2018 from http://devnot.com/2017/web-ve-mobil-uygulamalar-icin-firebase/
19. Google. (2018). Firebase helps mobile app teams succeed. Retrieved October 28, 2018 from https://firebase.google.com/products/
20. Avcı, O. (2015). Dosya konusu: Beacon teknolojisi nedir? Nerelerde kullanılır?. Retrieved November 6, 2018 from https://www.donanimhaber.com/Dosya-konusu-Beacon-teknolojisi-nedir-Nerelerde-kullanilir--77683
21. DOKO. (2017). BEACON NEDİR?. Retrieved November 6, 2018 fromhttp://www.dokotech.com/tr/beacon-nedir/
22. Kara, A. (2018). Beacon|Bluetooth Tabanlı Etkileşim Teknolojisi. Retrieved November 6, 2018 from https://www.endustri40.com/beaconbluetooth-tabanli-etkilesim-teknolojisi/

23. FSSoftware. (2018). Beacon | Bluetooth Tabanlı EtkileşimTeknolojisi. Retrieved November 6, 2018 from http://www.fsmobility.com.tr/genel/beacon-bluetooth-tabanli-etkilesim-teknolojisi/
24. Vara, G. (2017). “Beacon Me” Mobil Uygulaması, Emojileri Kullanarak Gezginlere Rehber Oluyor. Retrieved November 6, 2018 from https://www.uzakrota.com/beacon-me-mobil-uygulamasi-emojileri-kullanarak-gezginlere-rehber-oluyor/
25. Indigo. (2017). Beacon ve nesnelerin interneti bankacılık sektörünü değiştiriyor. Retrieved November 6, 2018 from https://indigodergisi.com/2016/07/beacon-ve-nesnelerin-interneti-bankacilik-sektorunu-degistiriyor/
26. Demirel, F. (2016, Sep 11). Chrome Android uygulamasına beacon desteği geliyor. Retrieved November 6, 2018 from https://webrazzi.com/2016/02/11/chrome-android-uygulamasina-beacon-destegi-geliyor/
27. Radius Networks.(2014, Nov 20). iBeacon Scavenger Hunt Application for iOS. Retrieved November 6, 2018 from https://github.com/RadiusNetworks/scavenger-hunt-ios-os