Original Research Article

Mobile-base Registration System for Blood Donation (MBRS-BD)

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ABSTRACT

In the healthcare management domain, blood donation receives a particular interest due to its crucial and vital importance in saving people's lives. In Iraq, the blood donation procedure usually consumes a lot of time for donors as it is carried out through a non-automated and paper-based process, which is done only in hospitals/ medical centers for those who are willing to donate. Patients who are in a need for blood donation may have to wait until they receive the service, and this may results in dramatic or undesired consequences. At the same, the blood donation procedure negatively affects people who are willing or wish to donate blood and mostly leads to ignore this matter by a lot of them unless there is a critical situation concerning one of their family members. This paper propose a Mobile-Base Registration System for Blood Donation (MBRS_BD) using Firebase Cloud Messaging (FCM) to manage the process of donor's registration automatically using a smartphone to simulate, ease, and minimize the time required for that. Donor can register in any available Iraqi hospitals/ medical center using MBRS-BD and go in the exact time to complete his/her donation process.

Keywords: Firebase Cloud Messaging, Blood Donation, Android, Healthcare, Information systems, Mobile system

1. INTRODUCTION

Healthcare management is a primary important and vital subject which has received a continuous interest from all involved parties and participants, governmental and non-governmental agencies all around the world. Numerous studies have been done in this field trying to investigate the most powerful and useful methods, methodologies, and applications to be implemented in healthcare field. Artificial intelligence is one of the powerful resolutions that healthcare workers employed in health care and diagnosis of diseases such as heart disease [1][2].Within this field, blood donation and blood bank management receive a special interest because they infect directly human lives. They are found in different hospitals or blood donors' societies mostly taking care of the blood donation procedure.

In Iraq, as in many developing countries, the vital matter of donating blood is done through a process which could be considered poor and has many drawbacks. As a patient needs blood for one reason or another, the hospital will inform relatives and friends to fetch donators of certain kind of blood type for patient. Next, the donors will donate blood in blood bank for the sake of patient.

This non-automated and paper-based procedure for blood donation in Iraq is very slow and time consuming because it depends completely on papers and instance need of blood. Besides that, blood may be not available to serve a patient suffering from a critical medical condition. The matter includes other important sub-matters, like the urgent need for a specific kind of blood type in a limited time period. This makes these two important

substances formalize a problematic issue because it has direct negative effects on human being survival.

This paper propose a Mobile-Base Registration System for Blood Donation (MBRS_BD) using Firebase Cloud Messaging to manage and ease the process of registering in any hospital/ medical center to donate blood by donors themselves.

2. LITERATURE REVIEW

Almetwally, Youssef and Alshorbagy (2014) suggested a framework for a donating system using mobile cloud computing to smooths communication between blood donors and health centers in an integrated group of all related health centers besides establishing blood donation communities throw social networks [3].

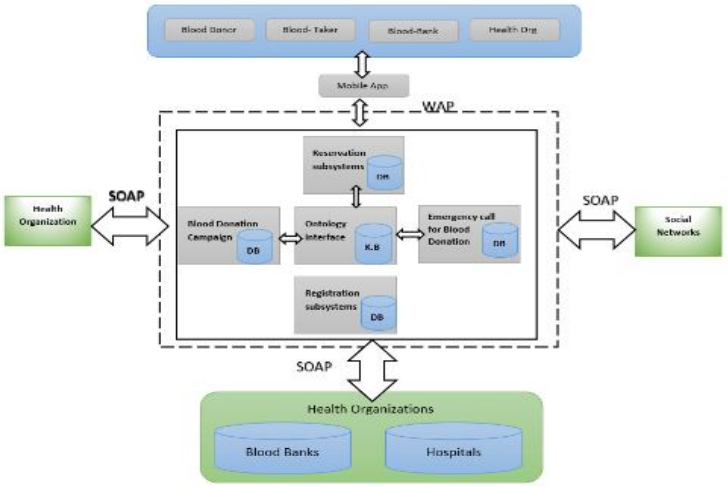

Fig. 1. Blood Donation System Architecture [3]

However, authors did not actually built the system nor mentioned specific mobile application to be used for this framework or even choose a cloud computing service nor a cloud computing model for the framework. Instead authors just mentioned that all cloud computing service models (IaaS, PaaS, SaaS) are involved in this framework, as shown in Fig. 1.

While Pavitra and Ahammed (2017) choose to describe their work as a “project” of an automated blood bank which depends on SMS to connect donors with patients who are in a need for blood donation. In their work, the donor register to the blood bank system using SMS then he/she should check his/her blood in a near health center/hospital so as the donor’s details are verified as a step before sharing his/her information in groups. An android APP is used so that blood donor will contribute in a donor’s list and if this type of blood is needed by any patient, he/she can use this list and communicate with donor through SMS. The project uses GSM modem interfaced to the controller i.e. LPC2148 [4].

Moharkar and Somani (2018) proposed an automated blood bank system for Indian blood banks/centers by grouping these blood banks/centers together and people who need blood in a sharable platform. The proposed system aims to find a blood-matched group with a specific blood type in the required timing. The proposed system suggests that the patient should use an android application and a Raspberry pi B+ acting as a computer for those who are in charge of blood banks/centers through a cloud server as a communication media.

Both blood banks/centers and patients use SMS to provide the patient with the ability to track up his/her request of blood group/type. The proposed system has 3 parts, namely: a raspberry pi board connected to server through a Wi-Fi connector, the blood bank administrator who is in charge of updating data in real time concepts, and the patient/user of the system who communicate with system using a special android application [5].

Wasim and Bhure (2016) decided to present a donor's system for students only using android application in order to request a blood donation. System also includes an ARM7 and GSM modem SIM900A. The main aim, as authors mentioned, is to reduce the time duration between the donor and receiver. Database of voluntary blood donor students was collected and information is fetched as soon as a blood need request is send through a message. The donor's data is send to patient with IP address attached the message. Doing that, as authors mentioned, will reduce time span between the donor and receiver [6].

Some researchers, like Seda, et al. (2016), discussed the blood donation from a management perspective by categorizing the process of donation through phases. Authors gave details and went through literature about every phase in the suggested system and discuss open matters besides proposing guidelines for future work. Authors concluded that there was a problem in managing the donors' appointments and visit to blood donation health centers which affect negatively over the entire blood donation process besides affecting negatively on donor's motivation to donate blood suggesting that their system presents a blood bag life cycle [7].

In Iraq, as far as researcher notice and after going throw literature, there is a limitation in discussing or proposing blood donation systems/ applications or blood management systems in general. Still, there was a paper by Mostfa, Alabass, and Sharkawy (2020) which suggested an android application for a blood bank mobile application to be applied only in Nineveh governorate. In this paper, authors proposed an application which offer a direct connection between the blood donor and receiver/ requester. The operation starts when a requester starts to search from a list of donors who matches the blood type he/she needs and then contact donors directly. Using Google Firebase Real-time database, a creation of donor/ requester profile is done as a two-way channel to send data forth and back between the donor and requester which will be stored later in JavaScript Object Notation (JSON) file. Fig. 2 shows the application architecture [8]. Thalassemia Association and Blood Bank Center in Mosul adopted the application over its networks and the application was put in a real working environment and successfully approve its objectives.

The application of Nineveh Blood donation has the major drawback of "direct connection" between the blood donor and the blood receiver. This matter is not applicable in many cases and reasons such as the avoidance of sharing personal information or computer literacy.

From the above discussion, it is obvious to notice that there is a limitation in automated blood donation process or/ and blood donation systems and applications in Iraq. The available paper until now [8] suggests a direct connection between donor and receiver without a regular registration process for donors in medical centers/ hospitals. Instead, the blood donor spot the requester in Nineveh governorate to reach and connect in order to do the donation process.

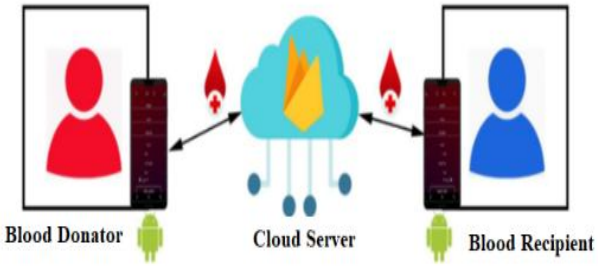

Fig. 2. Nineveh Blood donation application architecture

3. THE REQUIREMENTS TO BUILD THE PROPOSED MOBILE-BASE REGISTRATION SYSTEM FOR BLOOD DONATION (MBRS-BD)

The awareness of the major problem in this paper arise when researcher noticed the actual difficulties concerning the blood donation in Iraqi medical centers/ hospitals and began to investigate suitable and simple solutions for donors by adopting available technologies. Going throw literature, there was a noticeable limitation in discussing or proposing electronical solutions in Iraq. Today, smartphones which are devices that integrate the characteristics of computer operating system into a mobile phone [9], as part of wireless technologies has become the major mean for people to communicate and manage their lives, Iraq is no exception of this matter [10][11]. Statistics pointed out that the number of cellular mobile in Iraq in January 2021 was equivalent to 98.3% of total population with 40.01 million mobile connections [12] and reaches 42.54 million cellular mobile in January 2022 [13]. Which declares an increment of 1.7 million than previous year.

Because of that, developing an application for Mobile-base Registration System for Blood Donation in Iraq could help in stepping over existing difficulties and may save many people lives.

To develop the Proposed Mobile-base Registration System for Blood Donation (MBRS-BD), there is a need to describe its requirements, which are:

Android Smartphone:

The usage of an Android smartphone has proven to be higher than other smartphone usages (Fig. 3) [9], it is identified as the operating system for more than 2 billion devices [14]. In 2017 the Android applications reached 2.8 million applications compared to 2.2 million applications for iPhone [15] and expected to reach 228.2 billion application by 2022 [16]. Besides all of mentioned above, android mobile applications could be developed easily within all of its four constituents/ elements, namely: services, activity, broadcasting, and content providers [17-19].

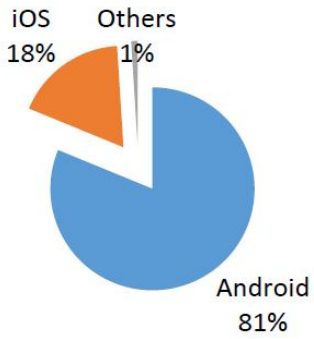

Fig. 3. Smartphone Distribution 2016-2017 [9]

All kinds of mobile devices, including Android devices have their own notification services which allow such service to be available for them. Android devices have the facility of smoothness in building applications using the available Push Messaging Service. In general, a Push Messaging Service is a message which is sent to a specific device automatically depending on the service that is used to send that message and what the user will be notified [20].

Mobile devices usually store huge amounts of personal information and data which is mandatory for users to use their mobile applications. Such information and data include push messaging technology. A cloud to device and a device to cloud messages are classified under the Device group messaging field which could be provided by Google Cloud Messaging (GCM) [20].

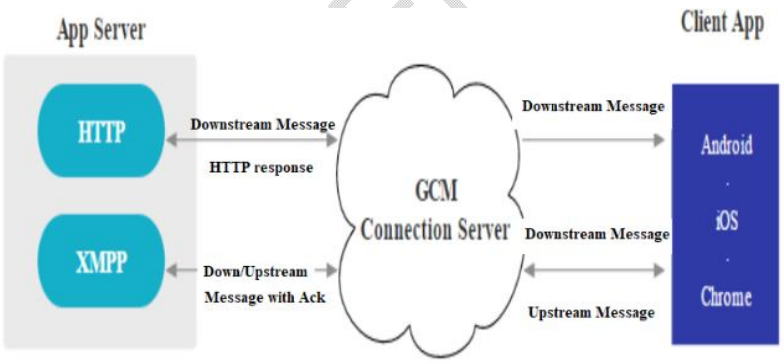

Fig. 4. GCM Architectural overview [20]

Firebase Cloud Messaging (FCM):

The proposed system suggests the use of Google Cloud Messaging (GCM) to accomplish the registration of donor information and get a message to confirm registration and the exact time to donate. Firebase Cloud Messaging (FCM) replaced GSM in 2016 in exchanging messages across the internet [21]. FCM, as shown in Fig. 5, is a cloud-base service which does not require any dedicated server to handle messages when mobile application use it and there is no need for data servers to exchange data [21, 25].

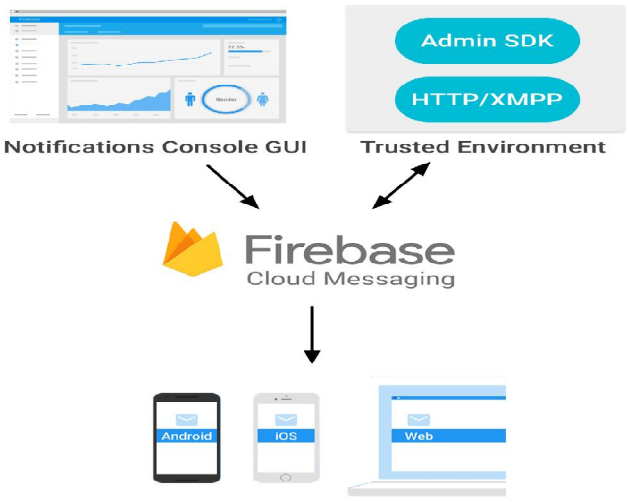

Fig. 5. FCM general architecture [25]

FCM general architecture FCM which inherits GCM core infrastructure, is defined as a cross-platform for messaging and notification solutions could be used for building interactive applications for multiple platforms such as iOS, android, tablet and others [21, 22].
Vital components of FCM architecture are [21]:

- FCM connection server.
- Trusted environment with application server based on HTTP / XMPP and suitable cloud functions.
- Client application.

The overall procedure of pushing a message service via FCM is illustrated in (Fig. 6) [23].

A third-party developer is responsible of managing the application server which will send messages to the subscribed application on the user's device using FCM server.

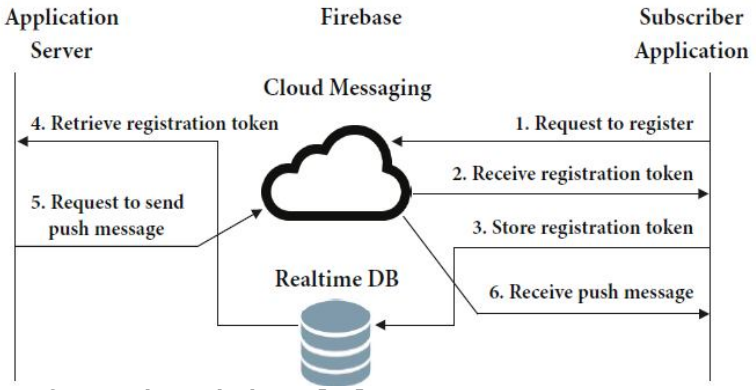

Fig. 6. Overview of procedure Firebase [23]

4. DESIGN AND IMPLEMENTATION

The general architecture of Proposed System: Mobile-Base Registration System for Blood Donation (MBRS_BD) is shown in Fig. 7. The system relies on building an application using

Android smartphone device and adopting the FCM facilities to accomplish the registration process for any donor who wishes to donate blood at any medical center/hospital in Iraq.

To build the mobile application, MIT APP Invertor2 which is a free cloud-base service [24] and available for Android devices and personal computer (laptop) was chosen. MIT APP Invertor2 provides a platform prototype of a “Designer Editor” and a “Blocks Editor” that allows the developer to create apps for Android devices. After the installation process, developing the application was achieved. The application was designed as an easy to use application with a user friendly interface.

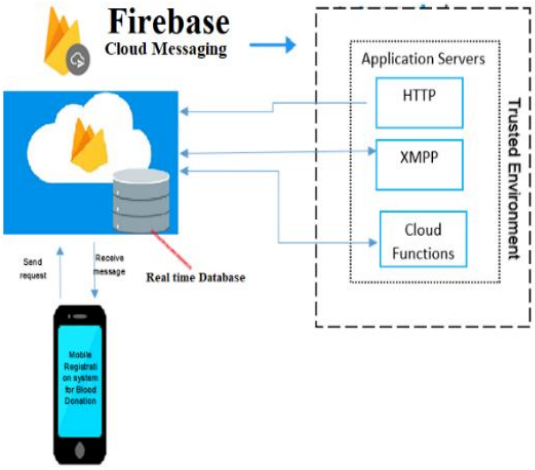

Fig. 7. General architecture of Proposed System (MBRS_BD)

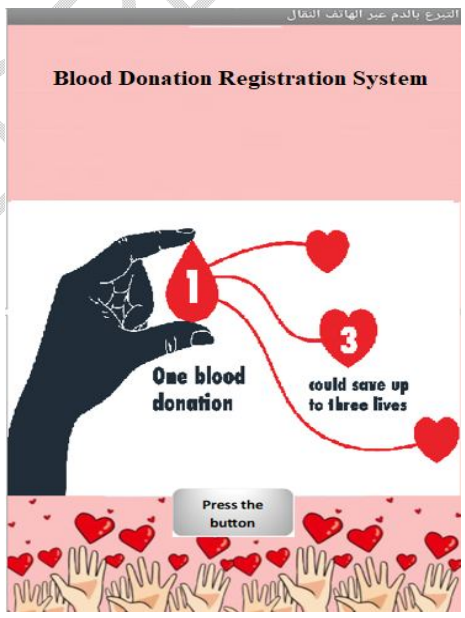

Fig. 8. Main Interface for Mobile Application

The First interface contains only a single button with label “press the button” to continue with the application (Fig.8).

The second interface of this application is a simple filled-in form dedicated for the blood donor to register is a specific health center/hospital, donor can choose nearest one to him/her. The form requires only basic information (Fig. 9). The first and second interfaces are programmed with the environment based block based environment for MIT App Inventor2.There are nine text boxes within the second, described as (donor's name, date of birth, Gender, blood type, donor's weight, address, mobile number, e-mail, and hospital). For the last mentioned information (hospital), the donor may choose the nearest hospital/medical center to him/her to donate which in turn will minimize time required for blood donation and encourage blood donation process for donor. Additional two buttons are added (submit, for submitting the pre-entered information and a cancel button to cancel the whole process of donation).

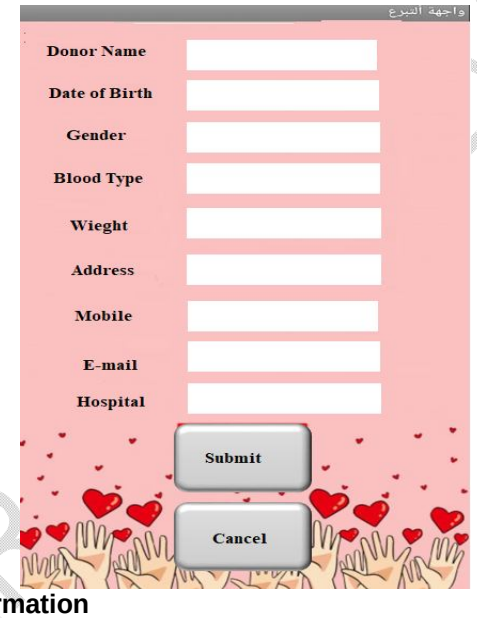

Fig. 9. Filling Donor’s Information

If the user/ donor fill information and press submit, the information will be send to a cloud database to be stored for further actions. Besides that, a confirmation message will appear to user/ donor to inform him/her that registration is done and the date and time for his/her blood donation will be send to him/her as soon as possible in another message (Fig. 10).

The proposed mobile-base registration system for Blood Donation (MBRS_BD) could be very useful to be used in Iraqi hospitals/ medical centers to manage and control blood donation registration process electronically. Besides that, it gives a motivation for a large number of people who are willing to donate blood but they annoy the present long time paper-based procedure for blood donation to do so.

The donor will get a specific date and time for him/her in a smooth way because all his/her information already available at the hospital and a specific date and time will be assigned for him/her, so no delay will occur.

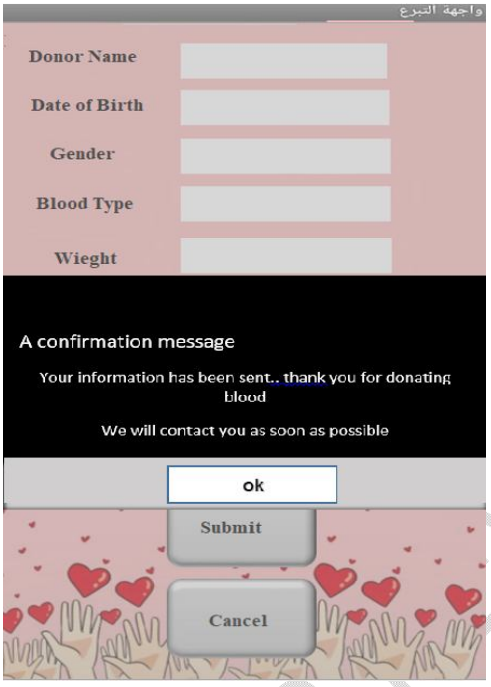

Fig. 10. The confirmation message

After submitting information, the donor's data will be stored in cloud looking like (Fig. 11). To store data using cloud firebase, a primary key is required to manage the process for data saving and control information retrieval. For this application, researcher choses the mobile number to be the primary key to store data because of its uniqueness in order to avoid repetition or mixing in data besides its facility of fast retrieval.

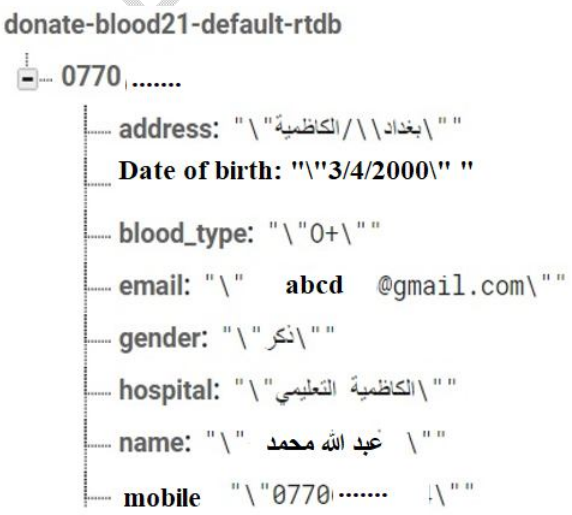

Fig. 11. Storing Data in Firebase

Note: The application provides the ability of storing data in Arabic language because it is the native language in Iraq to perform simplicity and easiness for people who are not familiar with English language.

5. CONCLUSION

Donating blood is a matter of substance. It is a major not minor issue which is suffering of many drawbacks in Iraq like paper-based dependency, slowness, and time consuming in blood donation process. The proposed Mobile-base Registration System for Blood Donation (MBRS-BD) in this paper proposes a management procedure for those who wish to donate blood in any Iraqi hospital/ medical center by registering their names using the proposed application and receive an exact date and time for them which will help in saving time for all involved people besides assuring a suitable management process for this matter.

REFERENCES

1. Mijwil M M, Shukur B S, Mahmood E Sh. The Most Common Heart Diseases and Their Influence on Human Life: A Mini-review. J Adv Med Med Res. 2022; 34(15),:26-36. https://doi.org/10.9734/jammr/2022/v34i1531396
2. Mijwil M M, Shukur B S. A Scoping Review of Machine Learning Techniques and Their Utilisation in Predicting Heart Diseases. Ibn al-Haitham J Pure Appl Sci. 2022; 35(3), 175-189. https://doi.org/10.30526/35.3.2813
3. Mostafa A M, Youssef A E, Alshorbagy G. A Framework for a Smart Social Blood Donation System Based on Mobile Cloud Computing. Health Inform Inter J. 2014; 3(4) pp:1-10. https://doi.org/10.48550/arXiv.1412.7276
4. Pavitra H, Ahmmed G F A. Design of SMS based automated blood bank using embedded system. Int J Eng Technol. 2017; 04(07), :1-4.
5. Moharkar A, Somani A. Automated Blood Bank Using Embedded System. Int J Innov Res Sci Eng Technol. *2018;* 7(1), :296-300. https://doi.org/10.15680/IJIRSET.2018.0701051
6. Wasim M, Bhure R. Intelligent Blood Bank Assistance using Embedded Systems. Int J Sci Eng Technol Res. 2016; 5(49), :10084-10087.
7. Baş S, Carello G, Lanzarone E, Ocak Z, Yalçındağ S. Management of Blood Donation System: Literature Review and Research Perspectives. Health Care Systems Engineering for Scientists and Practitioners. 2016; 169, :121-132. https://doi.org/10.1007/978-3-319-35132-2_12
8. Mostfa A, Alabass A, Sharkawy A. Nineveh Blood: Android Based Blood Donation Application for Nineveh Governorate in Iraq. *AL-Rafidain J Compu Sci Math*, 2020; 14(2),: 85-96. https://doi.org/10.33899/csmj.2020.167341
9. Sahani A. Android v/s IOS – The Unceasing Battle. Int. J. Comput. Appl. 2017; 180(3), :23-26.
10. Abdulrazak L F, Al-Tabatabaie K F. Impact of Mobile Phone on The Iraqi Society. *Int J Adv Res*. 2017; 5(1),:149-157. http://dx.doi.org/10.21474/IJAR01/2732
11. Altabatabaie K F. Adoption and appropriation of mobile phone on the Iraqi society. Int J Sci Technol Res. 2018; 7(7),:14-18.
12. Kemp S. Digital 2021: Iraq. 2021; Retrieved from https://datareportal.com/reports/digital-2021-iraq
13. Kemp S. Digital 2021: Iraq. 2022; Retrieved from https://datareportal.com/reports/digital-2022-iraq
14. Gao J, Li L, Kong P, Bissyandé T F, Klein J. Understanding the Evolution of Android App Vulnerabilities. *IEEE Trans Reliab*. 2021; 70(1),:212-230. http://doi.org/10.1109/TR.2019.2956690
15. Singh A K, Prajapati K S, Kumara V, Mishra S. Usage Analysis of Mobile Devices. *Procedia Comput Sci.2017;* 122, :657-662. https://doi.org/10.1016/j.procs.2017.11.420

16. Brilingaitė A, Bukauskas L, Kutka E. Detection of Premeditated Security Vulnerabilities in Mobile Applications. In Proceeding of European Conference on Cyber Warfare and Security. 2019; :63-69.
17. Nirumand A, Zamani B, Ladani B T. VAnDroid: A framework for vul-nerability analysis of android applications using a model-driven reverse engineering technique. Software Pract Exper. 49(1),:70–99. https://doi.org/10.1002/spe.2643
18. Khokhlov I, Reznik L. Android system security evaluation. In Proceeding of Annual Consumer Communications & Networking Conference, 2018; :1-6, Las Vegas, NV, United States. https://doi.org/10.1109/CCNC.2018.8319325
19. Schmeelk S, Aho A. Defending android applications availability. In Proceeding of Annual Software Technology Conference (STC), 2017; :1-5, Gaithersburg, MD, United States, 25-28. https://doi.org/10.1109/STC.2017.8234463
20. Thom C. Addressing Push Messaging Problems in Mobile Cloud Computing. 2016, Retrieved from https://www.researchgate.net/publication/327594677_Addressing_Push_Messaging_Problems_In_Mobile_Cloud_Computing
21. Albertengo G, Debele F G, Hassan W, Stramandino D. On the performance of web services, google cloud messaging and firebase cloud messaging. Digit Commun Netw. 2020; 6(1), :31-37. https://doi.org/10.1016/j.dcan.2019.02.002
22. Srivastava N, Shree U, Chauhan N R, Tiwari D K. Firebase Cloud Messaging (Android). Int. J Innov Res Sci Eng technol. 2017; 6, :11-18.
23. Hyun S, Cho J, Cho G, Kim H. Design and analysis of push notification- based malware on android. Secur. Commun. Netw. 2018; 2018 (8510256),:1-13. https://doi.org/10.1155/2018/8510256
24. Aziz T. Mobile App Development to Empower Educators and to Prepare Students as Future Leaders. 20115; Retrieved from https://docplayer.net/7520103-Mobile-app-development-to-empower-educators-and-to-prepare-students-as-future-leaders.html
25. Firdaus D, Priambodo B, Jumaryadi Y. Implementation of Push Notification for Business Incubator. Int J Online Biomed Eng. 2019; 15 (14), :42–53. https://doi.org/10.3991/ijoe.v15i14.11357