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When Wireless Technologies Faces COVID-19: via Apps using to Combat the Pandemic and Save the Economy

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A B S T R A C T

As the number of smartphone users grows, the smartphone's function in healthcare has evolved from a device that is used to arrange doctor appointments via the internet rather than the traditional approach. Mobile apps are a convenient way to track and collect data in order to combat the spread of COVID-19. To ensure that the right to privacy and civil liberties are maintained, we report on our investigation of 50 COVID -19- related apps, including their access to and use of personally identifiable information. Reservations are made at the doctor over the Internet, and an appointment is arranged for the visit and medical examination at a certain time, resulting in a reduction in the spread of the virus, especially in pandemic conditions such as Covid-19. Additionally, this provides a service for saving data and health files in the cloud on the Internet to retrieve information when needed, and not wasting these files and health papers while providing protection for them in terms of patient privacy. Designing an application (App) functioning on IOS and Android systems which works in mobile devices easily to provide the ability to book a doctor appointment from App. The App is a link between the patient and the doctor to reduce the patient's presence in health centers and medical facilities which are good centers for transmission of infection, especially in COVID-19. During the design of app, we have considered the low speed of data throughput especially for IRAQ.

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1. INTRODUCTION

Coronavirus is still spreading over the world, with over three million cases confirmed in 185 countries [1]. More than 200,000 people have died as a result of the disaster. Singapore and South Korea, for example, have done a better job than Spain and Italy. In their fight against the epidemic, Asian countries have deployed a variety of technologies. Digital technology has been widely used to aid in the reduction of coronavirus spread. In the midst of the COVID-19 outbreak, technology is vital to keeping our civilization running during lockdowns and quarantines. In addition to COVID-19, these technologies may have a long-term influence. The human race is once again being attacked by an infectious sickness (COVID-19). This time, it's a respiratory virus that first surfaced in December 2019 in Wuhan, China [1]. COVID-19 has a significant impact on almost every country on the earth, creating enormous disruption to the UN's noble Sustainable Development Goals (SDGs) [2]. As a result, the WHO classified it as a global pandemic in March 2020. COVID-19 has created widespread terror throughout the world, with fights over toilet paper looking to be particularly horrific; thankfully, there will be no fighting over food during this outbreak. COVID-19 is a worldwide concern, so experts from a variety of sectors, virology, data analytics, biomedicine, and artificial intelligence, have all contributed to the fight against the pandemic. In this setting, in less than four months, more than twenty-four thousand academic papers have emerged COVID-19 is available online [3]. Furthermore, Digital technologies are highly dependent on global activities and enterprises throughout this global crisis [4, 5]. Drones to monitor crowds, artificial intelligence and deep learning to evaluate health-care trends, tactile robotics to aid medical physicians and nurses in hospitals, during this global catastrophe, digital technologies are being used for supply chain automation and virtual learning to maintain education. In this worldwide pandemic, all of these vital applications rely on dependable, high-speed communication networks, which puts a tremendous load on them. In this context, the International Telecommunication Union (ITU) called an emergency meeting of the Broadband Commission for Sustainable Development, which instructed governments, businesses, and civil society to improve communication network capacity at critical locations such as hospitals and transportation hubs [6]. They also emphasized the importance of communication technology in delivering timely critical information, boosting e-businesses, and supporting e-learning for over 1.5 billion students. With all of this

technological assistance when we most need it, it is also fighting ongoing schemes to link the spread of COVID-19 to wireless communication fifth generation (5G) networks [7]. Because of this misinformation, people all over the world have attacked and burned 5G towers [8, 9]. To counteract this incorrect notion, wireless communications researchers responded in a variety of ways, demonstrating the usefulness of 5G in the pandemic situation and dismissing health worries about 5G operating frequencies [10, 11]. Now that we've agreed on the importance of technology in combatting the COVID-19 pandemic, let's look at how it's being used now and how it can be improved. In this study, we illustrate how technology is helping to battle the pandemic in terms of crowd monitoring, contact tracking, aiding medical professionals and nurses, enabling telemedicine, promoting virtual learning, and providing a reliable connection. We also show how crucial digital inclusion is in the fight against the pandemic, as well as potential strategies for connecting the unconnected. Following that, we go over some of the primary issues that have arisen as a result of the widespread usage of wireless technologies, such as privacy, security, and misinformation. Then we find the critical role of wireless technologies in averting the worldwide economic downturn caused by COVID-19, in addition to promoting e-commerce and aiding the most disadvantaged workers. Finally, we discuss how these technologies can be extrapolated in the aftermath of a pandemic. Fig. 1 depicts the involvement of wireless technologies in the COVID-19 epidemic.



Fig. 1. Depicts the involvement of wireless technologies in the COVID-19 epidemic.

1.1. Challenges

It is impossible to overestimate the role of wireless technology in controlling the COVID-19 epidemic. It does, however, face a number of challenges, including privacy, security, and disinformation. In the sections that follow, we'll go over each of these principles in more detail. Privacy: While contact tracking technology can help minimize virus propagation, they do encroach on people's privacy [12]. These apps may access and track users' location data, which

governments can utilize as a surveillance tool. Human rights activists throughout the world are afraid that using these applications to monitor the epidemic might become a widespread monitoring method in the future. Before deploying these applications, governments must answer a few questions without invading consumers' privacy. Is the user aware that his or her data is being gathered, and that the data may be removed once the pandemic is over? How long will countries save data collected during the COVID-19 pandemic? What will be the restrictions for sharing user data, and who will have access to it? Using drones to measure social distance or look for sick people in public places would also jeopardize privacy. Concerns about the right to privacy and freedom are raised by aerial surveillance [13]. Security: The increased usage of fixed and mobile internet connections during the COVID-19 epidemic has created a significant cybersecurity issue. An Akamai study claims that [14], In March 2020, global internet traffic increased by 30%, 10 times greater than usual. This is the first time this has happened usage of the internet exposes users to harmful attempts such as Phishing emails, malware injection into COVID-19-related resources, and even the selling of bogus COVID-19 cures are all examples of cybercrime [15]. Moreover, many business employees work from home, making providing authentication solutions for all users difficult. More hacks are likely as businesses get more online and follow e-commerce [16]. Additionally, businesses are becoming more automated, and technologies are becoming more linked than they have ever been, fraudsters may exploit a variety of weaknesses. During the pandemic, the fast development of new digital technologies might pose a huge cybersecurity threat.

1.2. Contribution

In this paper, we are going to design an app which can help in reducing the spread of COVID-19 between people. Achieving this, an App is designed through various steps: we are starting from structuring the database such as (Doctor, Health centers, Home, Notifications, User, timestamp) of patients. Next, designing the interface of the App from graphics perspective. After that, we have used a program language which is known as swift in parallel with Java to be used in IOS for iPhone devices and Android for other devices. At the end, we have managed to test the App with several samples (patients, and doctors).

1.3. The Aim of the paper

1. Reducing the amount of time, a patient spends at the doctor in order to limit interaction with other patients, hence lowering the risk of COVID-19 infecting other individuals.

2. The possibility of reservation from the same account for a number of illnesses. A person in the family can book for all family members at the doctor without the need to open new accounts.
3. Providing the possibility of storing medical files and papers related to the prescription, sonar and medical analyzes in the electronic cloud on the Internet.
4. The possibility of storing medical files for one patient, an infinite number of files.
5. Display these files and health papers in a smooth way, quickly fetch any file from the cloud, and the ability to search these files.
6. One account can store health files for many illnesses from members of his family, so it does not require a new account.
7. Technically, designing the App to function in a low data speed in order to facilities in most of IRAQ wireless communication system era.
8. Servers accept large number of users for example more than 5 million users without causing the server to stop or crash.
9. Building an application in terms of easy graphical interfaces, so that it provides the user with ease of use and accessibility to all application features.
10. The reservation is confirmed by the doctor's office, and the date of the doctor's visit is precisely determined, or the request is rejected.
11. The doctor can easily determine the days of his presence in the clinic from within the application and he can also suspend reservations temporarily.
12. The application supports multi-languages such as (English, Arabic, Kurdish and Turkish) which as languages spoken in Iraq.

2. EXPERIMENTAL PROGRAM

In this section we are going to present the structure of the App starting from: Platform, selecting the right language, designing the online data base, and designing the graphics of the Apps.

2.1. Platform (Native VS. Cross-Platform)

The discussion over whether a game should be native or cross-platform has been going on for a long time. For years, the tech world has been divided on this issue. Many people claimed to have discovered the ultimate solution, yet both cross-platform and native app development technologies are always changing. Due to the ever-changing nature of technology, it's a good idea to come back to these themes from time to time to see which of these possibilities is now leading. The native and cross-platform apps each have a dynamic set of advantages and disadvantages. These characteristics can have an impact on everyone engaged with the app,

including the app's owner, users, and developers. App developers now have preferences based on the technology with which they are most familiar. However, today's debate will be limited to app owners and users. Native apps are designed specifically for a platform. These applications are written in a platform-compatible language. For iOS, Apple chooses Objective C and Swift, whereas Google favors Java for Android. Developers can take advantage of the platform's inherent features by using these permitted languages. A native Android app will not work on an iOS device, and vice versa. Apps that run on different platforms are known as cross-platform apps. Because of the dominance of Android and iOS in the market, most cross-platform apps are limited to these two platforms. HTML and CSS are used to create these apps since they are platform agnostic. There are a number of cross-platform application development tools available that make it simple for developers to construct these apps. Let's compare cross-platform and native apps now that you know the differences Table 1 explain that [17].

Table 1 Native VS. Cross-Platform

Necessity to adopt the app architecture in order to deploy this app to multiple platforms	Multiple platforms deployment costs	With cross-platform development you can save up to 80% of project budget. Deployment to other platforms requires little additional investments
It presupposes the writing of app source code from scratch for each platform.	Development time	It reduces time-to-market, the code is highly reusable!
Developing an app for one platform you can lose up to 50% of potential app users	App users	It allows to promote the app through different platforms, thus targeting larger audience of users
In native development design is simplified by the services and support provided by the OS.	Design challenges	In a cross-platform environment developers have to add some features explicitly.
Native developer's skills usually cost more and are difficult to obtain	Programming expertise	Most cross-platform framework are web-based, this is it easier to find the required expertise among great pool of web developers.

Native apps take advantage of the platform's features while also maximizing available resources. This implies that native apps are fast, responsive, and free of crashes. Native apps can be optimized to emphasize the greatest features and capabilities of the platform if the developers have sufficient knowledge about it [17]. Features Native apps, notably on iOS, which runs solely on Apple's proprietary devices, can take advantage of the device's native features. Another significant advantage of native apps is that they support offline functionality, which is difficult to achieve with cross-platform programs. Because cross-platform apps have limited access to the API, they are unable to use the device's native

functionality. Because they are designed for a variety of devices with diverse capabilities, developers typically avoid making assumptions about the features that are available [17]. Feasibility Cross-platform apps take twice as long to develop as native ones. The cost is considerably higher because it frequently necessitates the development of many apps. Maintenance is both time-consuming and expensive, since developers must discover flaws and problems specific to each platform and provide separate upgrades. Cross-platform programs are less expensive to build and maintain. You're only going to invest in one app, which you'll have to keep up with. However, the increasing number of flaws and bugs may outweigh this gain on occasion [17]. User Experience The importance of user experience is growing by the minute, which is why it is the most important factor to consider while developing an app. Given the data shown above, this is a no-brainer. Native apps provide a fantastic experience with superior performance, speed, and device efficiency. Designers and developers have more creative latitude when it comes to creating attractive and well-functioning apps. Native apps are not just responsive, but they're also easy to use. While developers may create cross-platform products with identical user interfaces, this often comes at the sacrifice of performance. Meeting all of the UX requirements of several platforms at the same time is difficult for developers and designers. Cross-platform apps, on the whole, do not provide a satisfactory user experience [17].

2.2. Xcode(swift)

Xcode is Apple's macOS integrated development environment (IDE), which is used to develop applications for macOS, iOS, iPadOS, watchOS, and tvOS. It was initially released in 2003, and the most current stable release is version 12.5.1, which was released on June 21, 2021, and is available for download from the Mac App Store for free for macOS Big Sur users. Registered developers can get beta versions and previous versions of the suite from the Apple Developer website. CLT is part of Xcode and allows you to conduct UNIX-style work using the macOS Terminal app [18]. Major features Xcode supports Cocoa, Carbon, and Java development paradigms, as well as source code for C, C++, Objective-C, Objective-C++, Java, AppleScript, Python, Ruby, ResEdit (Rez), and Swift. Support for GNU Pascal has been added by third parties. Xcode can build fat binary (universal binary) files containing code for several architectures using the Mach-O executable format. The GUI tool Instruments is included in Xcode, and it operates on top of Sun Microsystems' DTrace dynamic tracing technology, which was released with Open

Solaris. Before beginning to design iOS apps, it's critical to grasp the App Life Cycle and the View Controller Life Cycle. So, today, we'll go through the life cycle of a View controller and a few fundamentals of View controllers. Fig.2 explain ios Apps Lifecycle [18].

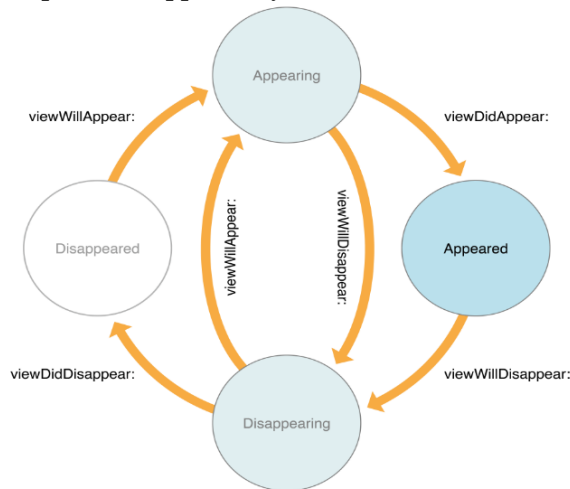


Fig. 2. Ios apps lifecycle

Load View: When a view controller is created from code, this method is used. It's best not to use this strategy at all. If the view controller is a.xib or a storyboard. What Does View Load Do? The view Controller manages the load View () operation. When the current view is nil, the view Controller calls it. Load View () is a function that loads a view (that you develop) and assigns it to the view Controller's view (superview) [18]. **View Did Load:** During the life cycle of a view controller, this method is only loaded once. When all of the views have loaded, it is referred to as. You can use this strategy to complete the following tasks: a) A once-only network call. B) User Interface. C) other tasks that must be completed just once [18]. **View Will Appear:** This method is called before the view is displayed to the user and before any animation is set up. The view has been bound in this procedure, but the orientation has not yet been specified. This function can be overridden to execute custom activities related to showing the view, such as hiding fields or disabling actions before the view is visible [18]. **View Will Lay out Sub views:** By default, it does not perform anything. When the limits of a view change, the location of its subviews changes as well. This function can be overridden by the view controller to make changes before the view puts out its subviews [18]. **View Did Lay out Sub views:** After the view Controller has been adjusted to its subview as a result of a change in its bound, this function is invoked. If you wish to update the subviews after they've been set, add code here [18]. **View Did Appear:** After the view on the screen, this method is called. Usually, data is saved to core data, r an animation is started, or a video or music is played, or data is collected

from the network. This approach is appropriate for this type of task [18]. **View Will Disappear:** Before the view is removed from the view hierarchy, this function is invoked. The views are still visible in the view hierarchy, but they haven't been removed yet. There haven't been any unload animations set up yet. Add code to handle timers, hide the keyboard, stop network requests, and revert any modifications to the parent UI in this section. This is also an excellent location for storing state [18]. **View Did Disappear:** After the VC's view has been removed from the view hierarchy, this function is invoked. Stop listening for alerts or device sensors using this way [18].

2.3. Android Studio(java)

Android Studio is the official integrated development environment (IDE) for Google's Android operating system, based on JetBrains' IntelliJ IDEA software and developed particularly for Android development, in Fig. 3 shows the life cycle of android Apps. It will be available as a free download for Windows, macOS, and Linux in 2020, as well as a subscription-based service. It replaces Eclipse Android Development Tools (E-ADT) as the leading IDE for native Android app development. In Fig 3 show android Apps Life cycle [19]. **On Create ()** This callback must be implemented when the system initially starts the activity. When you create an activity, it is marked as Created. The on Create () function is used to conduct basic application setup logic, which should only occur once over the lifetime of the activity. On Create () may bind data to lists, connect the activity with a View Model, and instantiate certain class-scope variables, among other things. For example, as an illustration This function accepts a Bundle object as an argument, which holds the activity's previously saved state. Any lifecycle-aware component associated with your activity's lifecycle will get the ON CREATE event. The @On Life Cycle Event method of your lif cycle-aware component will be invoked, allowing it to perform any setup code required for the newly generated state. Instead of defining the XML file and submitting it to set Content View, you may create new View objects in your activity code and form a view hierarchy by adding new Views into a View Group (). Then you utilize that layout to set Content View by passing the root View Group (). See the User Interface documentation for further information on how to build a user interface. In the Created stage, your activity does not exist. The activity enters the Started state after the on Create () function completes execution, and the system immediately invokes the on Start () and on Resume () procedures. The on Start () callback is discussed in the next section [19]. **On Start ()** When the activity reaches the Started

state, the system calls this callback. The on Start () method makes the activity visible to the user while the application prepares for it to reach the foreground and become interactive [19].

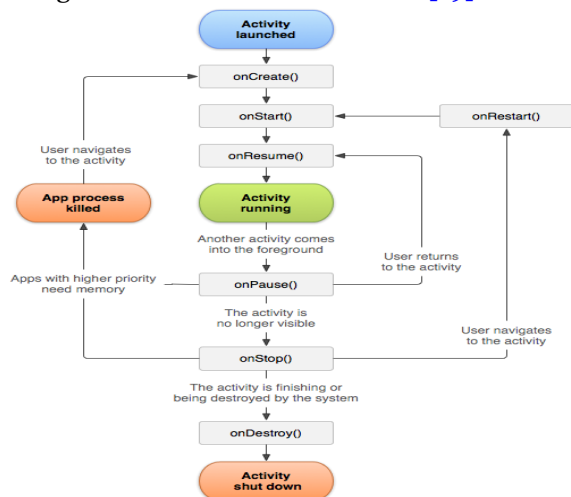


Fig. 3. Android apps life cycle

On Resume () When the activity is resumed, the system calls the on Resume () callback, which brings it to the foreground. In this level, the app interacts with the user. The app will remain in this state until the user's attention is drawn away from it. Such situations include receiving a phone call, the user moving to another activity, or the device screen going off. When the activity is resumed, 'very lifecycle-aware component tied to the activity's lifecycle will get the ON RESUME event. Lifecycle'components may be used to allow any activity that requires the component to be visible an' in the forefront, such as beginning a camera preview. When an interruptive event occurs, the activity enters the Paused state, and the on Pause () callback is called by the system. The system calls the on Resume () operation once again, if the activity returns from the Paused state to the Resumed state. As a result, whenever the activity enters the Resumed state, you should use on Resume () to re-initialize any components that were released during on Pause (), as well as any other initializations that are required [19]. **On Pause ()** The system uses this way to indicate that the user is quitting your activity; it indicates that the activity has moved to the background. When an Activity is in the Paused state and will be resumed soon, use the on Pause () method to pause or adjust operations that should not (or should be done in moderation) [19]. **On Stop ()** The system executes the on Stop () callback when a user can no longer view your action. This can happen when, for example, a freshly started activity fills up the entire screen. When an activity has completed its operation and is about to be terminated, the system may issue a Stop command (). When the activity reaches the halted state, the ON STOP event is sent to any lifecycle-aware component connected with the activity's lifecycle. The lifecycle components

can stop any functionality that isn't necessary, even if the component isn't displayed on the screen [19].

2.4. Firebase Powered by Google (DataBase)

Firebase evolved from Envolv, a prior company founded by James Tamplin and Andrew Lee in 2011. Envolv provides an API that allows developers to add online chat functionality into their websites. Following the debut of the chat service, Tamplin and Lee noticed that it was being used to carry non-chat application data. Developers utilized Envolv to synchronize application data such as game status among several users in real time. Tamplin and Lee decided to decouple the chat system from the real-time architecture that made it possible. They formed Firebase as a separate company in September 2011, and it went public in April 2012. Firebase's first service was the Firebase Realtime Database, an API that synchronizes data across iOS, Android, and Web devices and saves it in Firebase's cloud. The solution may be used by software developers to construct real-time, collaborative apps [20].

Firestore Advantages

1. There is no charge to begin.
2. The rate of development
3. An end-to-end platform for app development
4. It's Google's fault
5. Frontend development might be the emphasis of developers.
6. There are no servers involved.
7. It is equipped with machine learning capabilities.
8. Increases the number of people who visit your apps.
9. Error monitoring
10. Security

Firebase also provides a complete selection of tools to aid developers in their development efforts. For starters, Firestore and Firebase's Realtime Database are two database possibilities. Similarly, Firebase's integrated Cloud Functions allow for simple cloud media storage and serverless application development. The Firebase platform includes functionality for building, releasing, and monitoring applications, and it covers the whole development cycle for an application. It also provides methods to engage consumers and keep them using the app as the final phase in the development cycle. Firebase is preferred by developers all over the world because it allows them to concentrate on writing frontend code for mobile apps. Backend boilerplate code is minimized when using Firebase, allowing apps to be developed more quickly. Firebase simplifies application development while also lowering costs. Firebase may also be used by

developers and enterprises to standardize the backend environment by utilizing a single, simple-to-learn solution. The amount of training necessary to support a backend pattern is reduced, and frontend developers may handle the majority of the job. Fig. 4. explain Firebase options [20].

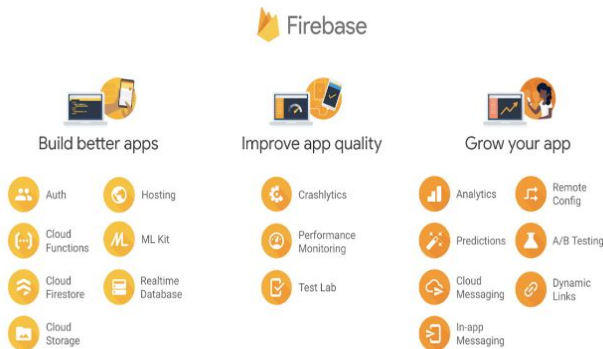


Fig. 4. Firebase options

3.1. Basic interfaces (pages)



Fig. 5. Login page

Login page Log in with one simple step by entering the phone number to be sent an SMS containing a confirmation code. Fig. 5 explain that.



Fig. 6. Home page, side menu.

Fig. 6 describes Home page: -It contains a group of animated advertisement pictures and also contains the medical departments and

under it there are the three highest rated doctors. The side menu contains the user's personal picture with the user's name as well and contains sub-pages (Profile, my medical file, Favorites, Health centers, Doctor, Settings, about, Log Out).

3.2. Book an appointment with the doctor



Fig. 7. Doctors List page, Doctor Profile page

Doctors List From the specialties on the home page, choose the specialty and enter the list of doctors (doctors are arranged in priority for the city in which the patient resides, then according to a doctor's review rate). Doctors Profile After choosing the doctor, the doctor's profile page is moved to the page, which contains (the doctor's full name, the doctor's picture, address and description about the doctor) and also contains a (heart-shaped button) through which the doctor can be added to the user's favorite list. Fig. 7 explain Doctors List, and Doctor Profile pages



Fig. 8. Tickets page (notifications) / user

In Fig. 8 show Tickets and user Pages. The reservation request is added to the ticket list and is in the waiting state until it is accepted or rejected by the doctor. You can only cancel the reservation if it is in a waiting state.



Fig. 9. Tickets page (notifications) /doctor

Tickets Page / doctor the doctor can accept or reject reservation requests also from the list of tickets. In the case of acceptance, the expected time for the patient's attendance must be specified and the possibility of writing a note or leaving it blank. Fig. 9 explain that.

3.3. My Medical File

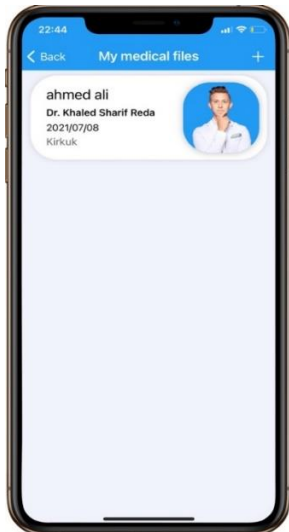


Fig. 10. My medical files page

My medical files: One of the application's most crucial features is the presence of an electronic cloud. Patients can upload pictures of their health files, which can make it easier for the doctor to follow the patient's health status. You can choose one of the previous files to be uploaded to the electron cloud or create a new file through the (+) sign. Fig. 10 show how to do that.

3.4. Upgrade an account to a doctor

Doctor page an account is upgraded to a doctor's account by entering the doctor's code in one easy step. Through it, the doctor can know the subscription date, the subscription expiry date, the number of confirmed requests and the number of rejected requests. As well as determining the calendar of the doctor's presence in the medical clinic by specifying days. Doctor page can be show in Fig. 11.



Fig. 11. Doctor page

3.5. Other pages

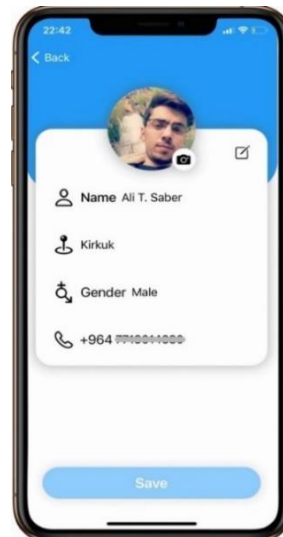


Fig. 12. User Profile page

Fig. 12 describes User profile page: -It contains the personal information of the user, the name and photo of the user, city, gender and phone number, and it can update (change) the data. Fig. 13 explain Settings page: -You can change the language of the application through the settings, as the application fully supports four languages (Arabic, Kurdish, Turkish, English).



Fig. 13. Settings page

4. CONCLUSIONS AND FUTURE WORK

The app has been designed to help the people booking their appointment in a clinic easily. Thus, for future work this app will be developed to have a medical file for anyone who is registered in the server. Results of this, the doctor in a specific filed will have access to the patient file so the doctor can see all the previous doctor diagnosis checks and analysis via a windows App. Also, the app allows the doctor to write notifications for others such as medical biological Lab., X-ray, Scanner, and the perception for pharmacist. All the notifications can be sent online via the App. In one hand, the patient no need to go and register in a biological lab, his\her name will be already existing. In the other hand, the biological lab sends the result directly to the doctor, so no need to print any paper. Also, the biological can reply to the doctor and write recommendations letter or open a discussion with the doctor, the same thing can be applied for the pharmacist. In the end, the patient will back to the doctor to explain for him\her the result. The doctor will upload all the results, the perception, and the doctor diagnosis decision in patient files.

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