Information Sciences Letters
An International Journal

http://dx.doi.org/10.18576/isl/120459

Mawidi: Smart Appointments Booking System for Social Distancing

Dabiah Alboaneen[*], *Fatimah Almohsin, Naba A. Almadan, Atheer Almarhoon, Hawra Almohssin, Thowiba Elawad Ahmed, Maha Alghamdi and Enas E. El-Sharawy*

Computer Science Department, College of Science and Humanities, Imam Abdulrahman Bin Faisal University, P.O.Box 31961, Jubail, Saudi Arabia

Received: 2 Jan. 2023, Revised: 2 Feb. 2023, Accepted: 27 Feb. 2023
Published online: 1 Apr. 2023

Abstract: In traditional systems of banks, the booking process requires the client to be in the same place, the client withdraws a numbered paper from an electronic device and then sits in the waiting area until his/her number appears on the screen. However, these systems may cause many problems such as wasting clients' time, overcrowding in the waiting area, slow workflow, etc. In this paper, a smart appointment booking system is developed to solve the problems of traditional booking systems of banks and achieve social distancing. The proposed system applies Quick Response (QR) code, Global Positioning System (GPS), and Bluetooth Low Energy (BLE) technologies to improve workflow and achieve social distancing in banks. The proposed system is developed on two sides. On the client-side, a mobile application is developed, a QR is generated for the user, which contains booking information, and GPS is used to determine the location of the client as it is only possible to book if he/she is within 100 meters from the bank. Due to the restrictions imposed caused by the spread of COVID-19, BLE technology works to ensure social distancing between clients. On the employee side, a website is created to enable the employee to deal with the client. The proposed system is expected to reduce problems related to traditional systems, gain client satisfaction, facilitate workflow for employees, and contribute to reduce the spread of COVID-19.

Keywords: Quick Response (QR) Code, GPS, BLE Technology, Social Distancing

1 Introduction

Nowadays, technology has taken over the entire world. Due to technological advances, it became possible for humans to do the tasks they need anytime and anywhere just by touching a screen or pressing a button [3]. Technology has become an indispensable part of all aspects of a human's life such as education, entertainment, business, shopping, etc. Scheduling appointments is one of the systems that helps humans in their daily lives. Basically, it is a system that stores all booking information. This allows the client to complete, cancel, and postpone their booking according to the restrictions of the organization that developed it.

Previously, appointment booking systems required the client to go to one of the booking points to collect a ticket or complete the booking, but everything has changed now that we can book in the home, office, and anywhere [15]. However, there are still institutions that require clients to come directly to make the booking, such as banks, post offices, hospitals, etc. The process of these systems is to withdraw a numbered paper from an electronic device that prints it, then sit in the waiting area until the client number is shown on the screen, and then proceed to the employee until he/she completes his/her requested service [17]. This process may cause several problems, such as overcrowding in the waiting area, wasting the client's time, and difficulty organizing workflow within the institution.

To solve these problems, an electronic registration system was developed in different organizations. For instance, an electronic ticket system in international stadiums instead of using the paper ticket to board a public bus with the Quick Response (QR) code. In addition, the ticket paper for booking parking was replaced by a QR code. Moreover, a waiting registration system was developed to solve the problem of crowding in hospitals. However, these solutions may be no longer effective due to the current situation caused by the spread of COVID-19 [18,2]. To deal with this pandemic, governments have implemented restrictions, like quarantines, shutdowns of educational institutions, shifts to

* Corresponding author e-mail: dabuainain@iau.edu.sa

online learning in some institutions, cancellation of public events, masks, and social distancing. Social distancing aims to limit physical contact among humans to reduce the chances of catching the virus and spreading it across the community [4].

In this paper, a smart appointment booking system is developed using a QR code, Global Positioning System (GPS), and Bluetooth Low Energy (BLE) to reduce the problems of the traditional system in banks that require the presence of the client to complete his/her services. In the proposed system, the numbered paper is replaced with a QR code that contains booking information and is used to identify the client. The client will be alerted when his/her turn is coming and notified of the employee who will serve him. To make the system compatible with the current situation, BLE technology is used to warn clients when the space between them is less than one and a half meters, and this will contribute to apply social distancing and hence reduce the spread of COVID-19 [2]. The proposed system does not allow confirmation of the booking unless the client is within 100 meters from the bank area. It does not require clients to enter the bank, and this will contribute to reduce overcrowding in the waiting area. It also helps banks' employees to avoid problems that may occur due to the client does not come for his/her appointment.

The main aim of this paper is to develop a smart booking system to solve traditional booking system problems and to help in social distance achievement. The aim is achieved by undertaking the following objectives:

–Use QR code technology instead of numbered paper to verify the identity of the client.
–Use GPS to provide flexibility for the client to confirm the booking without being inside the bank.
–Use Bluetooth technology to ensure social distancing between clients.

The remainder of this paper is arranged as follows. Section 2 presents the related work about booking systems. Section 3 explains the proposed model for appointment booking systems. Discussion and conclusion are discussed in Sections 4 and 5, respectively.

2 Related work

In traditional bank booking systems, the client withdraws a paper containing a number from an electronic device and then sits in the waiting area until his/her number appears on a screen. These systems require the client to be in the same place to obtain a booking [5]. When the client does not attend their appointment, this may waste the time of the client who is waiting after him/her, as well as the time and effort of the employee. Due to the current situation caused by the spread of COVID-19, these systems are no longer effective, as they do not contribute to achieving social distancing [6,7]. In these systems, the employee may call the client's number several times until the client comes to his/her office. Then, the employee takes the number and national ID to verify the client's identity and asks about the type of service he/she wants. This process may seem easy, but it may waste the employee and client's time, especially if the bank is crowded with other clients [8].

The QR code uses vary according to the needs of the institutions [9,10]. It has been used to confirm the attendance of appointments, store client's information, or as an alternative to paper tickets for buses and trains [12]. Besides using the QR code, GPS technology was used to locate students to prevent fraud and to ensure attendance of the event [12,13,11]. However, current studies revealed that Bluetooth technology is the most popular in use to achieve social distancing rather than GPS and Wi-Fi [1,14].

Through a review of studies, no solutions were found for traditional appointment booking systems in the current situation which is forcing social distancing to reduce the spread of COVID-19. Moreover, there is no integrated system that combines the use of QR codes and Bluetooth to solve problems related to the booking systems[16]. To conclude, the bank's appointment booking systems were not mentioned and the bank is one of the institutions that require the presence of the client to obtain services, so attention was directed to them in this research.

In this paper, a smart appointment booking system is developed for banks through the integration of QR codes, GPS, and Bluetooth. The QR code is used as an alternative to numbered papers, which can be sent to the client through an application on his/her phone. To avoid problems related to late cancellations of appointments, GPS technology will be used to make sure that the client is within 100 meters from the bank to confirm the appointment. To achieve social distancing between clients, Bluetooth technology will be used.

3 Mawidi: Smart appointments booking system for social distancing

The application starts with a welcome page that appears to the client when he/she opens the application for a short period. The new client fills in the data on the registration page and then clicks on the register button. On the login page, the client enters the email and password that he/she set during the registration process and then clicks on the login button. The main

page contains five icons; they are, appointments page, appointment booking, settings, social distance, and sign out. These icons are described as follows.

–**The appointments page:** shows a page containing a list of the appointments that have been booked.
–**The appointment booking page:** asks the client to enter the appointment information (service, time, branch), after which he/she clicks on the registration button to verify his/her location concerning the chosen branch. The application stipulates that the distance between the client and the branch does not exceed 100 meters, if it is less than 100 meters, the appointment will be confirmed. Therefore, if the distance is more than 100 meters, it is not possible to complete the appointment and the client is returned to the appointment-booking page [19]. These pages show different options regarding two choices, if the client has an appointment at the same time, an error message appears. However, if all the data are correct, he/she presses the confirmation button and a message appears that the appointment has been successful, then it moves to the complete appointment page, the client can press the generate button and a QR code is generated containing the client's information and appointment data to be scanned by an employee when the client goes to the bank, it also enables to upload QR code to the photo album.
–**Settings page:** contains four icons, data modification, change language, reset the password, and delete the account. The **change language page,**contains two options: Arabic language and English language. The client chooses the appropriate language and when clicking on the button, he/she notices that the language has changed to the selected language.**Data modification page,**which allows editing data [20]. If the client modifies his/her data, then he/she clicks on the save button to save the amendment, and then a message appears to him/her that the amendment has been saved successfully.
In the **delete account button,**a notification appears to the client, if he/she is sure of deleting the account. When he/she clicks yes, a message appears for him/her that the account has been successfully deleted. The **reset password page,**asks him/her to enter the previous password and the new password and confirm the new password, then click on the Save button to verify the entered data, if there is an error, an error message appears and is returned to the reset password page. When the data is correct, a message appears that the save was successful.
–**The social distance page,** requires clients to allow access to and share the site and to activate Bluetooth by clicking on start broadcasting, also it provided a high-frequency option to rapid updated and stop broadcasting option [20]. The application sends a notification to the client when the distance is less than 1.5 meters between him and the other client.
–**Log out page,** when the client clicks on the Logout button, the account is logged out.

3.1 Methodology

The details of the methodology are given below:

–Develop an Android app on the client side by using a QR code, which contains booking information, GPS to determine the location of the client, and BLE work to ensure social distancing between clients.
–Develop a website on the employee side that enables him/her to access a database through the website to be able to delete the service upon completion, or the client not attending and enable him to send a notification via email to the next client.

The software requirements are Android Studio, Cascading Style Sheets (CSS) language, Hypertext Pre-processor (PHP) scripting language, Java language, Java Development Kit package, and MYSQL database. The hardware requirements are Android Smartphone, the Android operating system, and a code reader.

3.2 Implemented application interfaces

–**Welcome page**
When the client opens the application, the application logo and a welcome message appear for a specified period, and then transfer to the login or registration page as a new user.

–**Homepage**
The client registers as a new user when he/she uses the application for the first time and has not previously registered with it, and when the client has an account, he/she logs indirectly.

Fig. 1: Dashboard page

Fig. 2: Make an appointment page.

–Login page
The login page requires the user to enter the email and password and click on the login button to enter the application, and there is also an option to forget the password when the client loses the password so that he/she can restore it.

–Registration page
The new user registration page requires the client to enter his/her triple name, email, mobile number, password, and confirm the password to verify its conformity.

–Dashboard page
The dashboard has several icons (booking an appointment – page of booked appointments – settings – social distancing - logout) and when the client clicks on an icon to access it, the application takes the client to the specified page. These icons are shown in Fig.1.

–My appointments page
On this page, the details of the appointments previously booked by the client are displayed. In addition, each booking contains the service, time, branch, and bar code for that booking.

–Make an appointment page
In Fig.2, the client will see services, times, and branches in drop-down lists, so that it enables him/her to choose the appointment's data. When the client clicks the booking button, the application will transfer him/her to calculate the distance page.

–Calculate the distance page
After confirming the appointment's data, the application transfer client to the distance calculation page as shown in Fig.3, which works on calculating the distance between the client and the pre-determined branch and making sure that

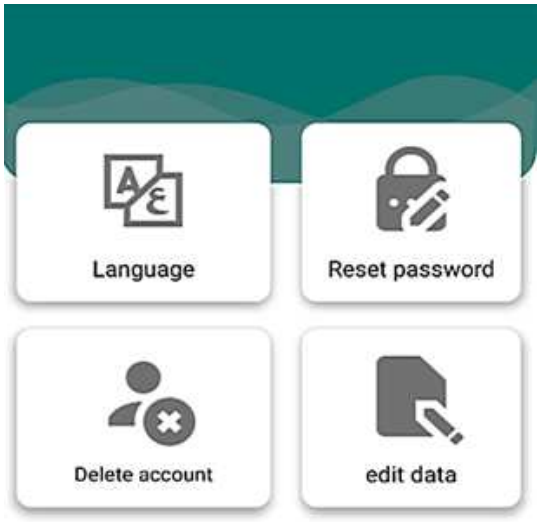

Fig. 3: Calculate the distance page.

Fig. 4: Setting page.

it is within 100 meters from the branch. If the distance is within 100 meters, the application will transfer the client to the confirm appointment page. If it is not within 100, the application will return to the make an appointment page.

–Complete appointment page

After booking the appointment, a message will appear stating that the booking was successful, and the option to generate a QR code will appear to display it on the screen, in addition to the option to upload it to the photo album.

–Settings page

The settings page contains four options as shown in Fig.4, which are: change the language, reset the password, modify the data, and delete the account.

–Change the language page

The application allows changing the language used based on the client's language, and there are two options (Arabic and English). When the client chooses the appropriate language for him/her, the application is updated and then transferred to the dashboard page, and the language of the application changes according to his/her choice.

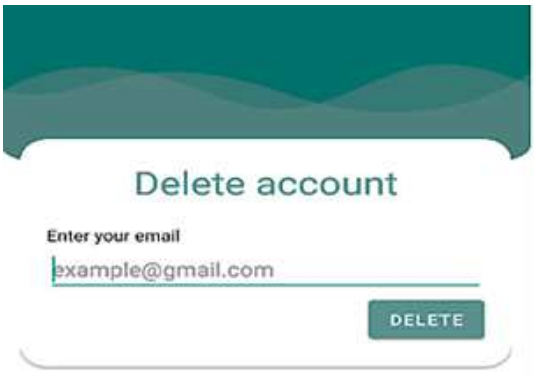

Fig. 5: Edit page.

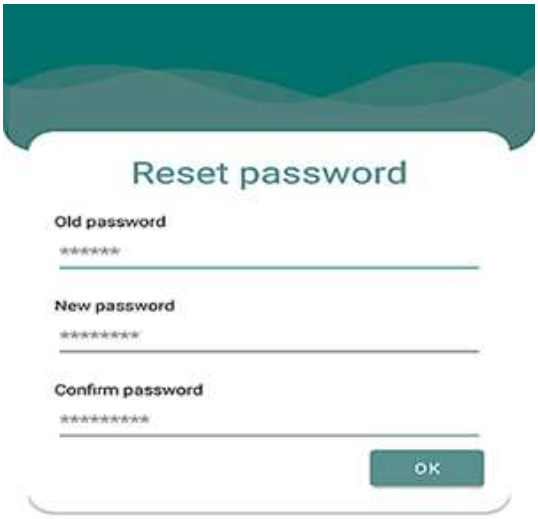

Fig. 6: Delete account page.

–Modify data page
In Fig.5, the client can modify the full name, email, and phone number through this page.
–Delete account page
The application allows deleting the account when it is not needed by simply entering the email that was previously registered with it and then pressing the delete button. This page is shown in Fig.6.

–Reset password page
In Fig.7, the application allows the client to reset the password and is required to enter the previous password and the new password and confirm the password.
– Social distance page
The application asks the client to allow access to his/her site and share it, allow Bluetooth to be activated. When the client presses the start-broadcasting button, social distancing is monitored so that if the distance is less than 1.5 meters between clients, an alert sound is sounded, and a notification appears to each client. In addition to the option to use the high frequency for a quick update, this option consumes more battery. It also allows the client to stop broadcasting.

3.3 Website workflow

The website works to serve the employee and the administrator to facilitate their work in the bank. On the login page, the employee and the administrator can log in. If the user is the administrator, he/she will be moved to the administrator's

Fig. 7: Reset client password page.

Fig. 8: Appointments page.

page, which contains five options: employee registration, employee removal, add services, add times, and logout. When choosing to register an employee, a form will appear that fills in the information of the new employee, which is the email, the office number, branch name, the password, and the confirmation of the password. After clicking on register, a notice appears stating whether the employee is already registered, or there is a mistake in confirming the password, or the registration has been successful. Whereas if it was chosen to delete an employee, a type of box will appear, in which the employee's email to be deleted is written. After confirming the deletion, employee data will be deleted from the database. When services are selected, a table of pre-existing services will appear, through which one of the services that the bank has stopped providing can be deleted. New services can also be added to the database by typing their name in the specified field and pressing confirm. Then it is made sure that the service to be added does not already exist, and after that, it is added. In the same way that services are deleted. Upon completion of the work, the administrator can log out with the logout button. If the user is a regular employee, the employee page will appear, which contains the three components of appointments, password modification, and logout. On the appointments page, a table will appear that contains the appointment data and two options, either send a notice or delete the appointment. When choosing to send a notification, the client will be notified that it is his/her turn and informed him/her of any office going to obtain the service, and after the service is completed, the end of the service is pressed and the appointment is deleted from the database. When the employee wants to change his/her password, he/she must first add the previous password correctly, add the new password and confirm it, and when there is an error, he/she will be notified to verify the validity of the previous password or confirmation. Upon completion of the work, the employee is logged off with the dedicated button.

3.4 Implemented website interfaces

–**Reset password page** Resetting the password requires the employee to enter the previous password and the new password and re-enter the new password as shown in Fig.9 to verify the match, then click on the change button to complete the password reset process.

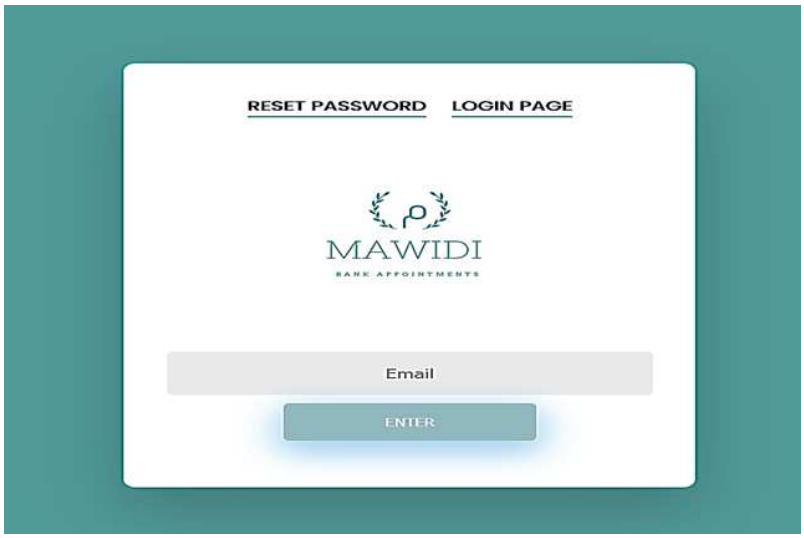

Fig. 9: Reset employee password.

Fig. 10: Forgot password page.

–**Forgot password page** In Fig.10, the forgot password page requires the employee to enter his/her email for the password to be sent to him/her on the previously registered with it.
–**Admin home page** The admin home page contains five buttons as shown in Fig.11, which are: Register a New Employee, Delete Employee, Add New Services to the Application, Add times, and Logout.
–**Registration page** When a new employee works for the bank, the admin creates a new account for the employee by entering the email, the office number in which the employee will work, the branch name, the password, and confirm the password to verify the match. This process is shown in Fig.12.
–**Delete employee page** In Fig.13, if the employee has left the bank, the admin will delete the employee's account by entering an email.
–**Add service page** If the bank provides a new service, the admin adds it to the database through the website, by typing the service name and clicking on the add button as shown in Fig.14, and a table appears on this page that contains all the services provided by the bank and allowing the admin to delete the service when he is not needed to it.

Fig. 11: Social admin home page.

Fig. 12: Add an employee page.

–Add time page In Fig.15, the configuration button is through which the database is cleaned from previous times, and the add button is through which times are added to the database.

4 Discussion

Mawidi application provides an online appointment booking service to the bank and monitors social distancing. The system helps to solve the problems of traditional booking systems by achieving the following goals: the GPS was used to ensure that the client was within 100 meters from the bank to ensure that the client attended the appointment. QR code was created instead of small numbered papers. In the circumstances of the COVID-19 pandemic, Bluetooth has been used to monitor social distancing between people, as the application makes a sound and sends a notification on the necessity of spacing if the distance is less than 1.5 meters. Ease of employee obtaining client data by scanning the QR code. By comparing the application Mawidi with the other existing applications, we can find that the Mawidi is similar to the other booking applications in one feature, which is using the QR code in the booking processes such as

Fig. 13: Delete an employee page.

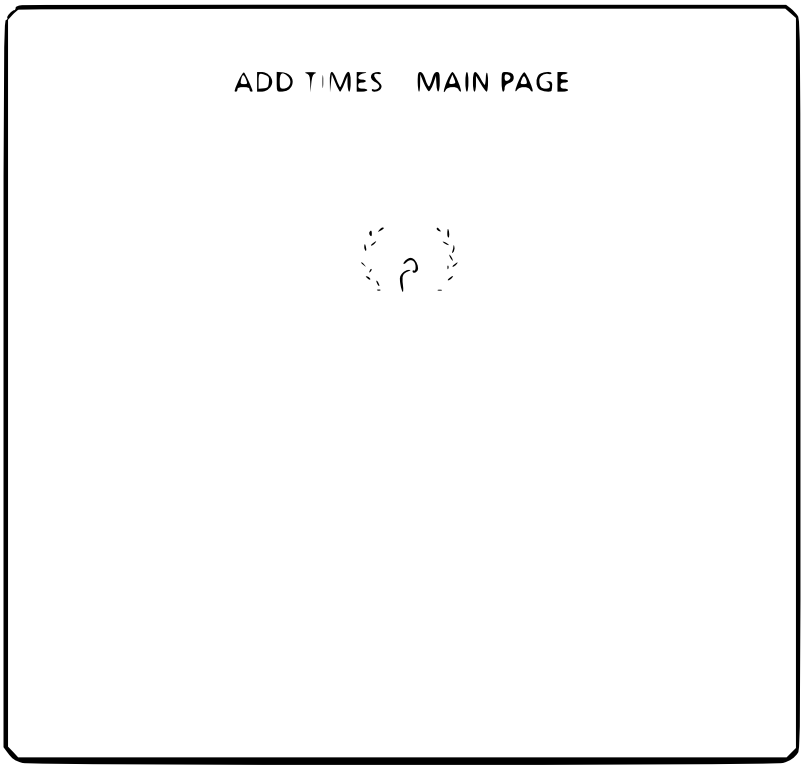

Fig. 14: Add service page.

confirming the attendance of appointments, storing client's information, and as an alternative to numbered paper. On the other hand, Mawidi has many features that are not included in the other applications, which makes Mawidi different and more useful and efficient. Besides using the QR code, Mawidi uses GPS technology to make sure that the client is too close to the bank. This feature is applied to avoid the late cancellation of appointments, which makes Mawidi distinct from other applications. Moreover, using Bluetooth to achieve social distancing exists as a standalone. In Mawidi, the use of Bluetooth is embedded in the application to achieve social distancing during the reservation process and services provided in the bank. This feature is not included in all applications. On the other hand, the website facilitates the work of bank employees in managing and organizing the reservation operations, which makes user satisfaction higher.

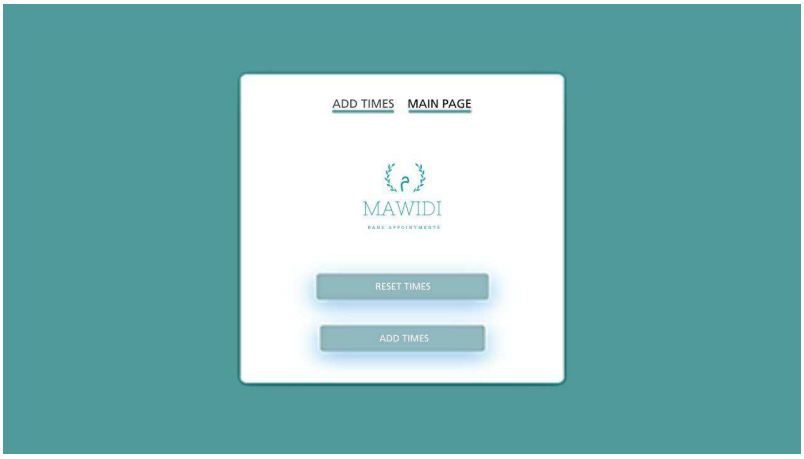

Fig. 15: Add times page.

5 Conclusion

Studies have shown that QR has never been used in the field of banking; furthermore, the spread of the COVID-19 virus leads to the need for applications that can reduce the spread of the virus by alerting people to maintain social distancing. Hence, an electronic application to book appointments has been created for banks, where the client can book an online appointment. GPS technology was used to locate clients, where the client must be within the scope of the bank's location at a distance not exceeding 100 meters so that he can confirm the booking. To reduce the use of small booking papers, it replaced them with a QR code, where the client's appointment data is stored in it, and when he goes to the bank the employee scans the code to verify the appointment's data. Under COVID-19, Bluetooth technology has been added to send an alert to clients if the distance between them exceeds less than 1.5 meters to achieve the principle of social distancing and maintain client safety. Through the previous points, it can be mentioned that the system combines the process of online booking appointments and monitors social distancing under the conditions of the COVID-19 pandemic. A deep-learning object detection technique can be used to detect a person in an image to automatically determine whether people maintain social distancing.

Conflict of Interest

The authors declare that there is no conflict regarding the publication of this paper.

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