

## CROSS PLATFORM MOBILE APPS TO SUPPORT PHYSICAL DISTANCING MANAGEMENT IN TRADITIONAL CHURCH DURING COVID-19 PANDEMIC

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Received July 2021; accepted October 2021

**ABSTRACT.** *Online mobile reservation system is designed and implemented to support physical distancing management in traditional church. Based on the general requirement analysis, main feature of the system is to facilitate seats booking as slots are limited during COVID-19 pandemic. Cross platform mobile development is implemented by using Flutter framework to develop application into Android and iOS devices. The apps are successfully delivered to Play Store and App Store, and it reaches up to 3556 users. The online mobile apps are supported by .Net framework as web service that is hosted in Windows server. The web service performs First Come First Serve method to decide reservation approval or rejection based on latest availability. Google sign in and Apple sign in are implemented to authenticate the user. The proposed work solves the real case to limit the number of visitors. Since June 2020, there are total 136 schedules and 22676 reservations are requested. The implementation of online mobile reservation system is considered successful as 89.5% of accepted reservation had been checked in.*

**Keywords:** Reservation system, Online mobile app, COVID-19

1. **Introduction.** Churches during pandemic still allow congregational worship by implementing health protocol based on country policy. In Indonesia, especially in Jakarta City, one of health protocol standards is to keep physical distancing which is by limiting number of people that only 25% of room capacities are allowed to gather at the same time [1]. Physical distancing is one of solutions to reduce the spreads of COVID-19 [2]. Limiting number of people gathered at the same time is the key to successful physical distancing implementation. Most of traditional churches do not have reservation system to facilitate chair booking before worship ceremony since churches used to always allow people to come as many as possible. A reservation system becomes a need to limit allowed people to come at the same time to church. Online reservation system is an effective and efficient solution for space booking and information delivery as it can be accessed from anywhere [3]. Nowadays, many areas have implemented online reservation such as e-commerce [4], railway reservation [5], room reservation [6], and online travel agency [7]. Especially for seats booking in church, online reservation system is obviously a new thing to implement. It has been found that several methods have been utilized as reservation system such as using google form or using microsoft excel and access database [8]. The

features are limited as the methods are not able to provide seats limiting, real-time information about availability, and ticket validation. To tackle the issues, in this study, the authors develop an online mobile application as reservation system to support physical distancing management. Smartphone platform is chosen as the media because it is popular and the number of smartphone users in Indonesia is huge, which is 191.6 million per 2020 [9]. To develop online reservation system, our proposed architecture implements mobile cloud computing which combines mobile cloud-based services and mobile application development [10]. The mobile app is developed using Flutter framework as it supports cross platforms development and is highly optimized to adapt mobile environment [11]. The mobile app allows users to see information about available worship schedules, reserve chairs and read important information about the church. As reservation is limited, the reservation system is working by implementing First Come First Serve [12] method that will automatically and directly approve the reservation request if there is chair available. Approved reservation has barcode ticket as validation before entering the church. Reservation system is applied in one church during pandemic since June 2020. As the mobile app is developed in multiplatform, the distribution is conducted via Google Play Store & App Store.

Physical distancing management in selected church is considered successful as it reaches 89.5% attendances of approved reservations. By utilizing the online mobile app, controlling number of people gathered at the same time can be done in effective and efficient way as the app can be accessed from anywhere and anytime. The implementation in the selected church can be a basis guideline for another church or place to manage physical distancing. The rest of the paper is organized as follows. Section 2 will have the system architecture and implementation. Result and discussion including app features, app distribution, total users, and reservation data will be in Section 3. Finally, Section 4 will elaborate the study conclusion.

**2. System Architecture and Implementation.** Figure 1 shows system architecture of the proposed online mobile app to support physical distancing management for church visitor.

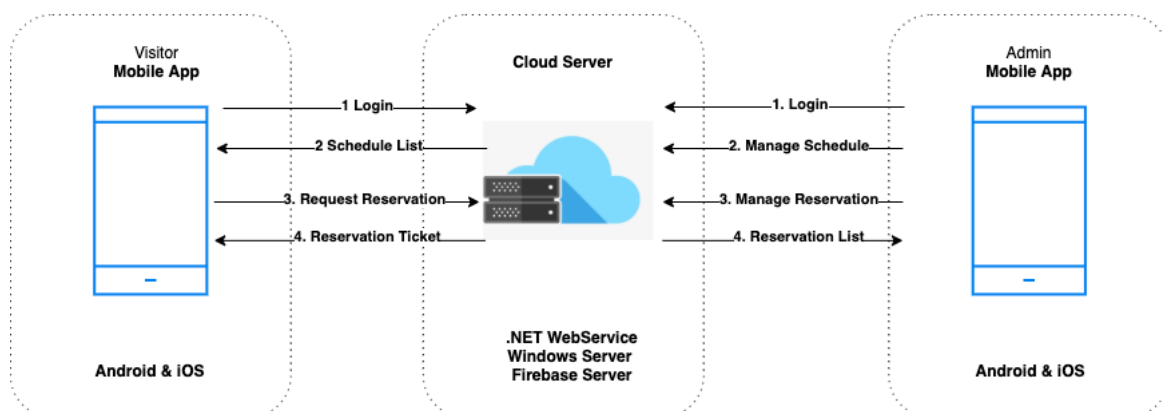


FIGURE 1. System architecture

The architecture consists of 3 main parts as follows.

**2.1. Mobile app for visitor.** The mobile app is built using Flutter framework in purpose to support multiplatform including Android and iOS. To make reservation, a user has to log in to the application using Google login or Apple login. After login, the mobile app will request available schedule list which contains information such as schedule date, time, and available seats. To make a reservation, a user must choose available schedule

and fill all required reservation data. After sending the reservation request, the mobile app will receive reservation ticket if there is still available ticket. Otherwise, the mobile app will receive and show no availability message.

**2.2. Cloud server for storage & reservation processing.** Cloud server has responsibility to manage user and reservation data. Every role of users that log in to the application is decided by webservice application. Webservice application is developed using .Net framework to support communication between mobile app and database. Figure 2 shows First Come First Serve method is implemented by the webservice to manage the reservations requested by mobile application. First, reservation is created by user by using mobile application. Mobile application requests the reservation creation to server. Second, webservice app will check the seat availability in the database on user reservation. Third, webservice will compare the availability with number of requested seat(s). Fourth, if the availability is greater than or equal to the requested seat(s), the webservice will directly accept the reservation, save to database, and finally send user the information about the accepted reservation. On the other hand, if requested seat(s) is greater than the availability, webservice will directly send no availability message to mobile app. Multiple requests will be queued and processed based on its arrival time. The webservice also supports admin user to manage the schedules including creating, updating, and deactivating the schedules.

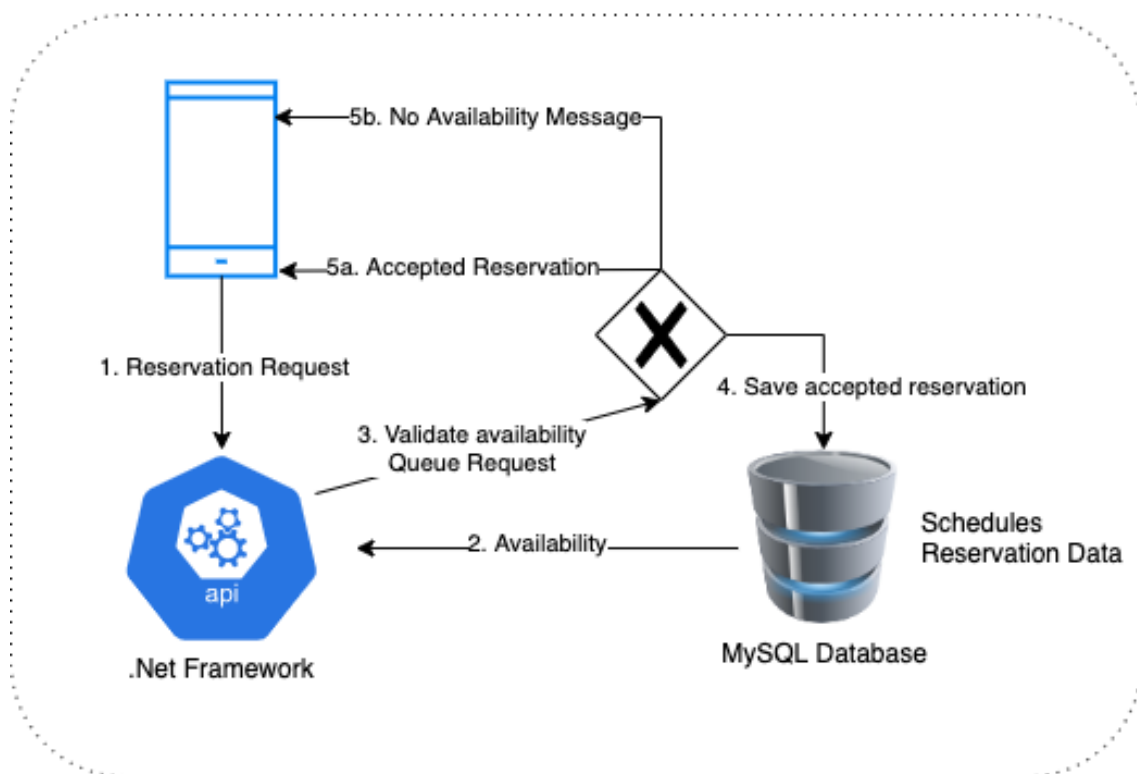


FIGURE 2. First Come First Serve method

Cloud server consists of 2 servers which are Windows server and Firebase server as shown in Table 1. The Windows server is the place for database and webservice hosting, while Firebase server is the place for user credentials and analytics data.

**2.3. Mobile app for admin.** Mobile app for admin is the same application with visitor application. The user is differentiated based on role that is received after login. Admin user can manage church information, manage schedules and reservations. The reservation request is processed automatically by webservice, but admin user is also able to manage the request manually.

TABLE 1. Server specification

Component	Specification
Windows server	OS: Windows Server 2008 R2 64 Bit Memory: 32768MB Processor: Intel®Xeon®CPU E31220 @ 3.10GHz Storage: 2TB
Webservice API	.Net framework with visual basic
Google Firebase server	Firestore authentication Firestore analytics

### 3. Result and Discussions.

3.1. **App features.** Figure 3 shows all features for visitor such as login, church information, available schedules, reservation, and reservation ticket.

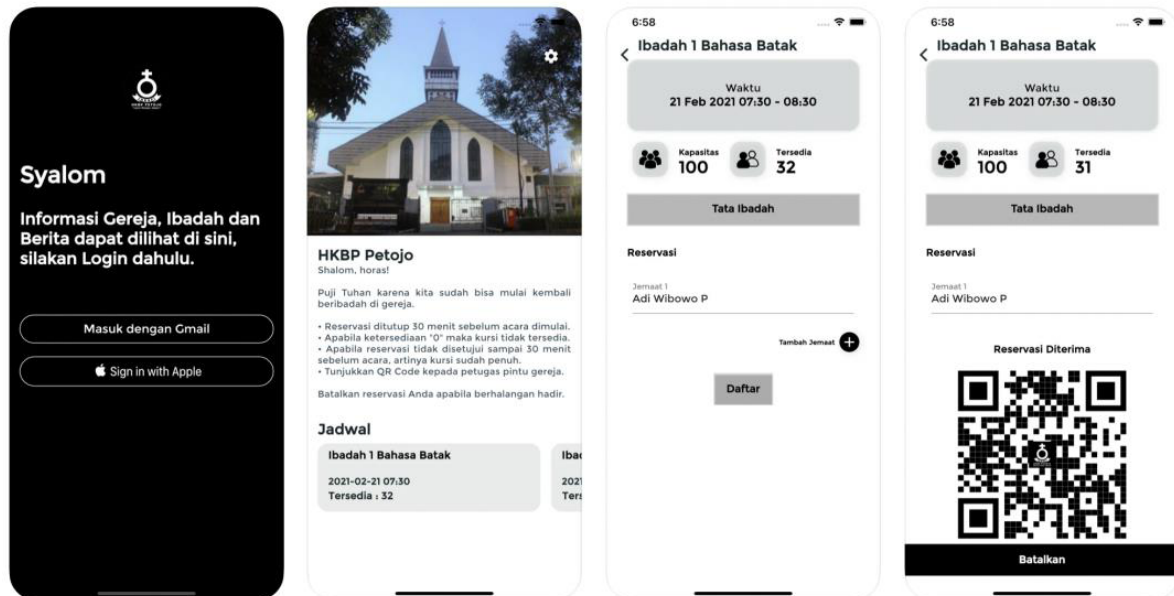


FIGURE 3. Features for visitor

On the other side, all features for admin user are shown by Figure 4, including schedule management, reservation approval & rejection, barcode validation, church information management.

The application only has Indonesian language as the target user is only Indonesian people. Through this app, visitor can see the availability and make reservation. The reservation ticket is a must to have to be able to enter the church during pandemic.

3.2. **App distribution.** The authors deploy the applications for 2 platforms which are Android & iOS mobile phone. Hence the distributions of the applications are conducted through official store of both platforms which are Play Store and App Store.

The first version of Android app is released on August 6, 2020 and can be downloaded from <https://play.google.com/store/apps/details?id=org.petojo.mobile>. On the other hand, the first version of iOS app is released on January 20, 2021 and can be downloaded from <https://apps.apple.com/id/app/hkbp-petojo/id1549877361#?platform=iphone>.

3.3. **Total users.** Figure 5 shows Firebase authentication dashboard which contains total registered user to the system per July 18, 2021. There are total 3556 users that have downloaded and logged into the application.

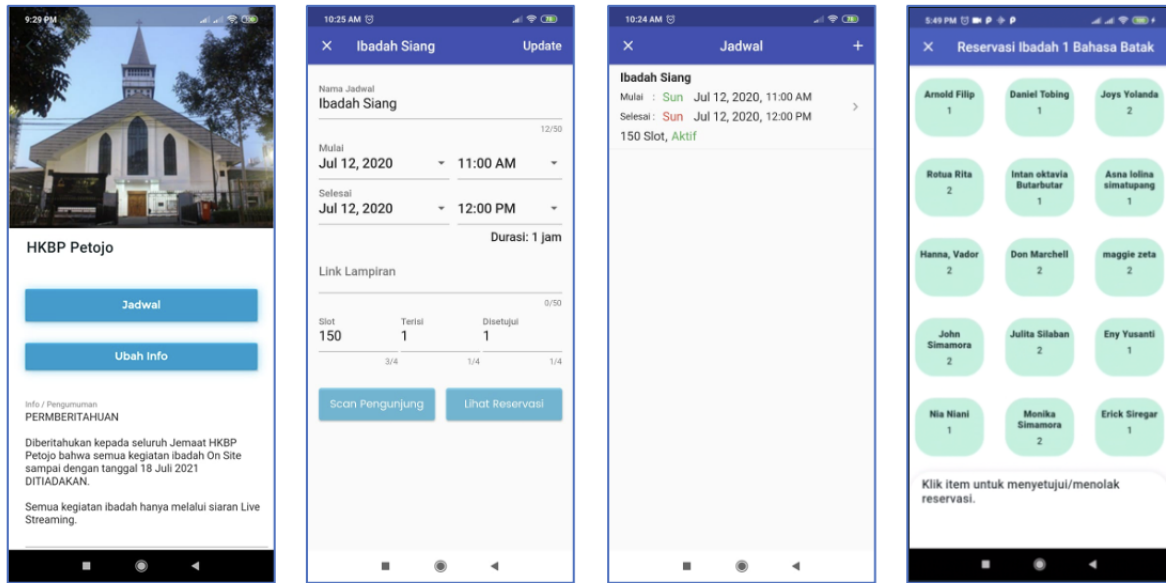


FIGURE 4. Features for admin

HKBP Petojo		Authentication		Go to docs
imgur.com	5 Sep 2020	6 Sep 2020		
imgur.com	22 Dec 2020	22 Dec 2020		
imgur.com	14 Mar 2021	14 Mar 2021		
imgur.com	2 Jan 2021	2 Jan 2021		
imgur.com	6 Sep 2020	6 Sep 2020		
imgur.com	16 Aug 2020	16 Aug 2020		
imgur.com	11 Oct 2020	11 Oct 2020		
imgur.com	22 Dec 2020	22 Dec 2020		
imgur.com	20 Mar 2021	6 Jun 2021		
imgur.com	23 Aug 2020	23 Aug 2020		
imgur.com	21 Dec 2020	21 Dec 2020		
imgur.com	18 Dec 2020	20 Dec 2020		
imgur.com	24 Feb 2021	27 Feb 2021		
imgur.com	3 Jan 2021	3 Jan 2021		

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FIGURE 5. Total user

As shown in Figure 6, based on Firebase analytics dashboard, the users are divided into 91% of Android users and 9% iOS users.

3.4. **Reservation data.** Table 2 shows statistic of reservation data since June 2020 until June 2021. 89.56% of accepted reservation had been checked in, and it implies that 89.56% of user that has accepted reservation come to visit the church. The rest of user probably skip the ticket validation or do not attend the reserved schedule.

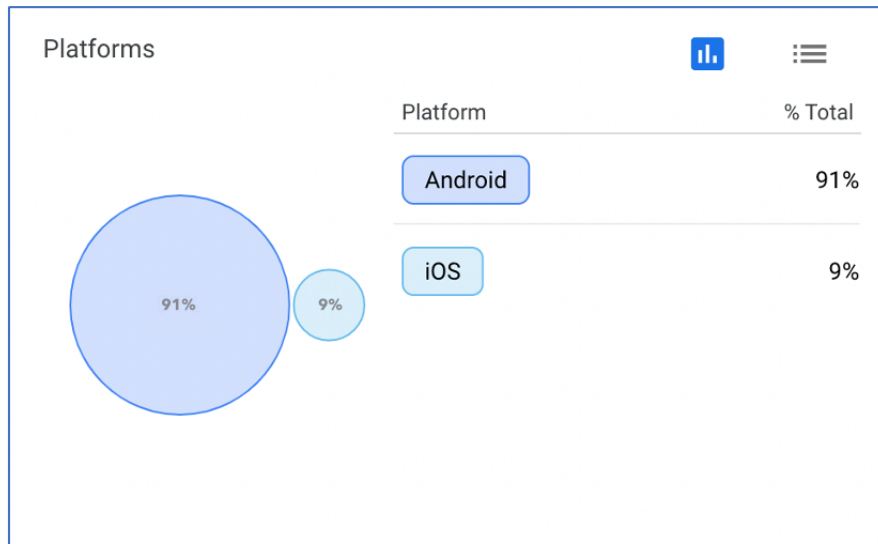


FIGURE 6. Platforms distribution

TABLE 2. Reservation data

Total schedules	136
Total reservation	22676
Total checked in	20309

Since there is no cancellation scenario implemented, the reservation will remain active until the worship schedule is over.

**4. Conclusions.** Online reservation app is proposed, successfully implemented and utilized in the real scenario. With this system, physical distancing can be managed by limiting number of visitors in every worship schedule. The seats availability is customizable and can be updated based on limitation percentage from country regulator. A new policy is applied to supporting the system that is every visitor must show reservation ticket to enter the church. The cross platforms apps are successfully distributed via Play & App Store and reach 3556 users. The reservation system is considered successfully as 89.56% of total approved reservation had been checked in. In the future the authors will continue to add features for multiple churches or places and add cancellation scenario.

**Acknowledgment.** The publication of this research is fully supported by Bina Nusantara University.

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