Development of Android Based Hajj and Umrah Pilgrims Monitoring Application In Dago Wisata International

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Abstract
Hajj and Umrah are worship activities carried out by Muslims around the world. The problem that often occurs during the implementation of the Hajj and Umrah is that pilgrims are often lost and separated from the group. Pilgrims also find it difficult to look for prayers because they are still using guidebooks, they have to look for prayers one by one in the feeling of a busy and hot holy land. The case study was carried out at Dago Wisata Internasional. The solution used is utilizing geofencing technology and Firebase Cloud Messaging that allows the process of monitoring pilgrims to be carried out easily and the pilgrims can get prayer notifications in accordance with the location of pilgrims. Research supporting data obtained from interviews with employees of Dago Wisata Internasional and literature studies. Based on testing on the application that has been built, the following results are obtained 93.33% supervisor states that this application simplifies the process of monitoring pilgrims, 84% pilgrims states that they can get help easily from the supervisor using this application, and 86% pilgrims states that that application makes it easy for pilgrims in looking for the practice deeds.

Keywords— Hajj and Umrah, Android, Geofencing, Push-notification, Firebase Cloud Messaging (FCM)
1. INTRODUCTION

Hajj and Umrah are worship activities carried out by Muslims around the world. Dago Wisata Internasional is a tour and travel agency that provides Hajj and Umrah services that was established on August 28, 2007. In the practice of Hajj and Umrah, problems that often encountered are the pilgrims that missing or lost. In Medina, a week after the pilgrims arrived, precisely on Monday, July 17, 2018, as many as 328 pilgrims got lost when they wanted to return from Masjid Nabawi, it is a report from Indonesia Hajj Committee[1].

In the practice of Hajj and Umrah, the travel agency provide guides to accompany and give direction to the pilgrims. Problems that experienced by the mentor are the pilgrims are often separate from their group and the pilgrims that go alone without informing the mentors. To monitor the pilgrims, mentors only uses radio transmissions that are one-way. The pilgrims also experienced some problem, they are often separated from the group because the situation in the holy land is crowded, and Indonesian people bodies are relatively smaller that pilgrims from other countries. The difficulty that is also felt by the pilgrims is finding directions or gathering points, because direction only use English and Arabic, and even the officer in the holy land only speaks Arabic. Another problem is the pilgrims have the lack of knowledge about Hajj and Umrah practice and prayers. Travel agency provides guidebook for the pilgrims, but this guidebook sometimes confuse the pilgrims, because the pilgrims must look for prayers in the crowded situation, especially in dark conditions.

Android currently dominate more than 90% of the smartphone market in Indonesia[2], so pilgrims monitoring tools will be built on android platform. In this research, the technology used is Geofencing, Google Maps API, and Firebase Cloud Messaging (FCM). Geofencing is a virtual fence that fence in certain areas by using the Google Maps API [3]. By integrating Geofencing, Google Maps API, and FCM is expected to be the solution of the problems that experienced by the mentors and pilgrims. Therefore, this research will conduct “DEVELOPMENT OF ANDROID BASED HAJJ AND UMRAH PILGRIM MONITORING APPLICATION IN DAGO WISATA INTERNASIONAL”

The objectives of this research are (1) Facilitate the mentors in monitoring pilgrims with a two way digital tools, (2) Make it easy for pilgrim to ask for help from the mentors when they get lost or separate from their group, (3) Prove practices information that must be done by the pilgrims based on location automatically using Fire base Cloud Messaging (FCM).

2. METHODS

2.1 State Of The Art

Based on several previous studies[4]-[5], the application that built for prayer information are still less effective, that is because pilgrims still have to search for prayer in a difficult situations, that is why in this study, the application that was built was given push notification technology. Push notification technology needs on applications that are built are implemented using FCM (Firebase Cloud Messaging), based on several studies[6]-[8], FCM will be effectively used in this application because it can provide notifications in real time.

Based on the research with the same case study, the technology that often used for pilgrims monitoring is GPS tracking [9]–[11], GPS tracking only works to send the location of the objects that being tracked while geofencing can limit certain areas so that when pilgrims enter the geofencing area, geofencing will trigger FCM to send notification [12], then the application can provide prayer notifications according to the pilgrims locations.

The application have panic button future, this future can be use when pilgrims are needed help or getting lost. Panic button report will go directly to the mentor phone, with the rule that if the panic button was pressed by more than 1 person, it will be set based on the closest distance to the mentor by using haversine method. According to a research [13], haversine is a formula that can calculate the shortest route between two points, by using the haversine method, mentor
will not be confused choosing which pilgrims will be picked up first because it has been given a recommendation according to the closest distance.

After conducting studies with previous studies, it can be concluded that the advantages of this application are, this application will be effectively use by user because it can provide prayer information notification in real time based on pilgrims location, and as a monitoring support, this have real time monitoring fitur that using panic button, pilgrims can use this panic button if they are need help from the mentor.

2.2 Theoretical Basic
2.2.1 Android

Android is a Linux-based operating system for cell phones. Android provides an open platform for developers to be able to create their own applications and can be used by a variety of mobile devices [14].

2.2.2 Firebase Cloud Messaging

Firebase Cloud Messaging (FCM) is cross platform messaging that allows to send notifications or messages to users at no cost and reliability [15].

2.2.3 Geofencing

Geofencing is a location-based technology that allows software to set boundaries or virtual fences around geographic locations, by regulating geofencing, software that is created can receive notifications when a device is triggered by geofencing (for example, such as exiting or entering a geofencing area) [16].

2.2.4 Google Maps API

The Google MAPS API has more than 150 million place data and can help users find places using telephone numbers, addresses and signals in real-time [17]. API (Application Programming Interface) is a collection of protocols, functions, and commands that can be used to build certain software [18]. Based on the explanation above, it can be concluded that the Google Maps API is a function to connect applications with Google Maps, so that applications can access the features available on Google Maps.

2.3 Software Development Methods

The Software development model uses is the prototyping development model, which is a systematic software development model [19]. The prototyping model consists of communication, rapid design, rapid modelling, development, and implementation of testing. The stages in the prototyping model can be seen in Figure 1.

![Prototype Development Model](image)

**Figure 1** Prototyping Development Model
2.4 Problem Analysis

Based on interviews with the head of the IT department at Dago Wisata Internasional (DWI), Mr. Dani, it is known that in one trip the pilgrims consisted of 70% elderly, 20% adults, and 10% teenagers or children. It is also known that DWI does not yet have a capable monitoring system, because it still uses radio transmission, so it is still difficult for mentors to monitor the pilgrims who are separated from their group. The next problem was that the guidance given to the pilgrims is still in the form of a small guidebook.

2.5 Analysis of Built Application

The system that built is named “Go-Jiroh”, Go-Jiroh can be used if the user has installed the Go-Jiroh application on their smartphone and have an internet connection. The Go-Jiroh Application has two access rights, the guide and the pilgrims, and it has backend application that can used by administrators to input the pilgrims, mentors, and prayers data. The following general application architecture can be seen in Figure 2.

![General Application Architecture](image)

Figure 2 General Application Architecture

General description of the application architecture built are (1) Admin enters the guide and pilgrims data into the database and then creates a mentor and congregation account, (2) The mentors can log in and access data provided by the database, (3) Pilgrims can login and access data provided by the database, (4) Google Maps provides maps that can be accessed by mentors, and admins can enter the practice data into firebase and firebase can push notifications.

2.6 Technology Analysis

2.6.1 Firebase Cloud Messaging Analysis

Firebase Cloud Messaging (FCM) is a technology that allows to send notifications from different platforms. The following is a general description of how FCM works in a system which can be seen in Figure 3.

![FCM General Flow on System](image)

Figure 3 FCM General Flow on System
Description of the general flow of the FCM on the system are (1) Pilgrims enter the geofencing area, (2) Geofencing triggers Firebase to send notifications to the user's application (3) Firebase sends notifications to user applications

2.6.2 Geofencing Analysis

Geofencing is a technology for creating virtual fences in certain geographical areas. The following is a general geofencing path in the system that can be seen in Figure 4.

![Geofencing General Flow on System](image)

Figure 4 Geofencing General Flow on System

Description of the general geofencing path in the system are (1) Pilgrims enter the geofencing area, (2) Geofencing requests to the database, (3) Web service bridges requests for tokens and geofencing data to the database, (4) Web service sends geofencing location data from the database to Google Maps, (5) Google Maps displays geofencing data in the application.

The locations used as geofencing points for Umrah can be seen at Table 1.

| No | Location     | Radius | Longitude | Latitude     |
|----|--------------|--------|-----------|--------------|
| 1  | Bir Ali Mosque | 0.5 Km | 24.413924 | 39.542951    |
| 2  | Masjidil Haram | 2.5 Km | 21.423069 | 39.825722    |
| 3  | Safa Hill     | 0.2 Km | 21.422009 | 39.827398    |
| 4  | Marwah Hill   | 0.2 Km | 21.425358 | 39.827235    |
| 5  | Nabawi Mosque | 0.5 Km | 24.467528 | 39.611072    |

Table 1 Umrah Geofence Location

The locations used as geofencing points for pilgrimage can be seen at Table 2.

| No | Location     | Radius | Longitude | Latitude |
|----|--------------|--------|-----------|----------|
| 1  | Bir Ali Mosque | 0.5 Km | 24.413924 | 39.542951 |
| 2  | Masjidil Haram | 2.5 Km | 21.423069 | 39.825722 |
| 3  | Safa Hill     | 0.2 Km | 21.422009 | 39.827398 |
| 4  | Marwah Hill   | 0.2 Km | 21.425358 | 39.827235 |
| 5  | Mina          | 8 Km   | 21.418324 | 39.875574 |
| 6  | Arafah        | 1 Km   | 21.355133 | 39.984108 |
| 7  | Muzdalifah    | 1 Km   | 21.389146 | 39.923650 |
| 8  | Nabawi Mosque | 0.5 Km | 24.467528 | 39.611072 |

Table 2 Hajj Geofence Location

2.6.3 Google Maps API Analysis

The Google Maps API is a technology for facilitating technology exchanges for maps, routes and locations. The following is a general flow of the Google Maps API on the system which can be seen in Figure 5.
Description of the general flow of the Google Maps API on the system are (1) The application requests the current location of worshipers and mentors (2) Web service bridges requests made by applications, (3) Web services send requests made by applications to the Google Maps API, (4) The Google Maps API responds by providing the location of pilgrims and mentors, (5) Web service bridges the response provided by the Google Maps API, (6) Web service sends responses provided by the Google Maps API to the pilgrims and mentors application, (7) The application displays the map.

2.6.4 Use Case Diagram

Use case diagrams are diagrams that illustrate the sequence of interactions between actors and systems. Actors are humans or machines that interact with systems to do certain jobs [20]. Use Case diagrams are used in the analysis phase of developing and gathering software requirements [21]. Use Case for applications that are built can be seen in Figure 6.
2.7 System Planning

Mentor home page interface planning can be seen in Figure 7.

![Figure 7 Mentor Interface Planning](image)

Pilgrims home page interface planning can be seen in Figure 8.

![Figure 8 Pilgrims Interface Planning](image)

2.8 Implementation

Mentor home page interface implementation can be seen in Figure 9.
Pilgrim home page interface implementation can be seen in Figure 10.

3. RESULT AND DISCUSSION

3.1 Blackbox Testing

Blackbox testing is done for functionality testing of the built system. The result of blackbox testing for admin backend application can be seen in Table 3.
Table 3 Admin Blackbox Testing Result

| No | Testing Component     | Testing Point                                           | Result      |
|----|-----------------------|--------------------------------------------------------|-------------|
| 1  | Login                 | Empty input data                                        | Success     |
|    |                       | Wrong input data                                        | Success     |
|    |                       | Correct input data                                       | Success     |
| 2  | Tambah user           | Incomplete or empty input data                          | Success     |
|    |                       | All filled and correct input data                       | Success     |
| 3  | Ubah user             | Empty input data                                        | Success     |
|    |                       | Input data changed and filled                           | Success     |
| 4  | Hapus user            | Press the delete button and do cancellation              | Success     |
|    |                       | Press delete button and do confirmation                  | Success     |
| 5  | Halaman list pembimbing | Displayed mentor list                                   | Success     |
| 6  | Tambah pembimbing     | Incomplete or empty input data                          | Success     |
|    |                       | Correct and filled input data                           | Success     |
| 7  | Ubah pembimbing       | Empty input data                                        | Success     |
|    |                       | Input data changed and not empty                         | Success     |
| 8  | Hapus pembimbing      | Press the delete button and do cancellation              | Success     |
|    |                       | Press delete button and do confirmation                  | Success     |
| 9  | Halaman list Jamaah   | Displayed pilgrims list                                | Success     |
| 10 | Tambah jamaah         | Incomplete or empty input data                          | Success     |
|    |                       | Correct and filled input data                           | Success     |
| 11 | Ubah jamaah           | Empty input data                                        | Success     |
|    |                       | Input data changed and not empty                         | Success     |
| 12 | Hapus jamaah          | Press the delete button and do cancellation              | Success     |
|    |                       | Press delete button and do confirmation                  | Success     |

The result of blackbox testing of mentor frontend application can be seen in Table 4.

Table 4 Mentor Blackbox Testing Result

| No | Testing Component     | Testing Point                                           | Result      |
|----|-----------------------|--------------------------------------------------------|-------------|
| 1  | Login                 | Empty input data                                        | Success     |
|    |                       | Wrong input data                                        | Success     |
|    |                       | Correct input data                                       | Success     |
| 2  | Pantau jamaah         | Displayed all pilgrims location                         | Success     |
| 3  | List jamaah           | Display all pilgrims list                               | Success     |
| 5  | History Laporan       | Display pilgrim help request list history               | Success     |
| 4  | Laporan               | Display pilgrim help request                            | Success     |

The result of blackbox testing of pilgrims frontend application can be seen in Table 5.

Table 5 Pilgrim Blackbox Testing Result

| No | Testing Component     | Testing Point                                           | Result      |
|----|-----------------------|--------------------------------------------------------|-------------|
| 1  | Login                 | Empty input data                                        | Success     |
|    |                       | Wrong input data                                        | Success     |
|    |                       | Correct input data                                       | Success     |
| 2  | Lihat map             | Display current location and mentor location             | Success     |
| 3  | Doa amalan            | Display prayers and practices list                      | Success     |
| 4  | Cari Pembimbing       | Display mentor location and route to mentor             | Success     |
| 5  | Kontak pembimbing     | Display mentor phone number on phone call               | Success     |
| 6  | Panic button          | Send help message to the mentor                         | Success     |
| 7  | Notifikasi doa dan amalan  | Receive prayers and practices notification when entered geofencing area | Success     |
3.2 Likert Scale Testing

Likert scale testing is done by giving a statement directly to 3 admins, 3 mentors, and 10 pilgrims to see and observe how users think about the application. The maximum assessment of a Likert scale test is 5, so the formula to calculate the criteria can be used, as can be seen formula 1 [22].

\[ \text{Kriterium} = \text{Max Ratings} \times \text{Number of Respondents} \]  \hspace{1cm} (1)

Then, the value of the questionnaire obtained for the admin is \(5 \times 3 = 15\), for the mentor is \(5 \times 3 = 15\), and the pilgrims is \(5 \times 10 = 50\). To calculate the answers from respondents in the form of a percentage can be seen in formula 2 [22].

\[ P = \frac{\text{total value}}{\text{ideal score}} \times 100\% \]  \hspace{1cm} (2)

Information:
- \(P\) = Percentage value sought
- Total value = Number of frequencies times the specified value
- Ideal score = Criterion score

Admin Likert scale test results can be seen in Error! Reference source not found..

![Figure 11 Admin Likert scale test results](image)

Mentor Likert scale test results can be seen in Figure 12.

![Figure 12 Mentor Likert scale test results](image)
Pilgrims Likert scale test results can be seen in Error! Reference source not found..

Figure 13 Mentor Likert scale test results

4. CONCLUSIONS

Based on research that has been done, it can be concluded that (1) Advisers can monitor pilgrims easily by using this application, and this application is two-way, (2) Pilgrims can easily ask for assistance to the supervisor with the features of the panic button and telephone supervisor in this application, (3) Pilgrims can easily search for the prayer practice with the practice notification feature automatically based on location.

5. SUGGESTION

Suggestions for future application development are, (1) Solve problems experienced by users if there is no internet network, (2) Complete prayers and practices on the application, (3) Add prayer and practice features with sound for worshipers who cannot read Arabic, and make it easier for elderly worshipers who are already difficult to read, (4) add a chat feature that can send pictures to mentors and pilgrims to make locating easier.

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