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Development of Airport Airside and Landside Facilities Inspection Application: Enhancing Safety and Efficiency

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Abstract

Digital transformation, or digitization, has positive impacts on income, business, and organizational performance. Mobile applications, designed for smartphones, have become a part of everyday life and are used in various fields, such as communication, travel, transportation, and tourism. In the transportation sector, mobile applications have been used for navigation, traffic safety, and transportation inspections, which is reducing paper usage and improving efficiency. Mentawai Airport, a replacement for Rokot Airport, is the focus of application development research because it still uses paper-based facility inspection. The Airport Facilities Inspection Report (AFIR) aims to improve efficiency and effectiveness in inspection activities. Making applications using the Appsheet program. The research method uses research and development and the testing method uses the Black Box method. How the AFIR application works can be used online or offline with Android or iOS-based hardware. The AFIR application database uses Google Sheets with cloud storage on Google Drive. The test results using a black box show that the AFIR application can be used well. The output from the AFIR application is PDF inspection files, inspection documentation, and spreadsheet files of inspection data results.

1 INTRODUCTION

Digital transformation, also referred to as digitization has become a very popular term in academia and industry. This concept is closely related to business transformation supported by IT. Several researchers argue that digitalization provides positive impacts such as increasing new income opportunities, increasing business [1], digital business opportunities [2], and increasing company/organization performance [3]. This is enhanced by cloud technology, cloud computing, big data, social media, and connectivity [3]. One of them is the use of applications on smartphones which have become part of everyday life and are considered preferable compared to other media [4]. Applications or so-called mobile applications are software applications designed to run on smartphones, tablets, and other mobile devices [5] [6] [7]

The history of applications began with the development of the first mobile device which was only used to send and receive voice calls in 1973. Then it continued with early applications in the form of arcade games, ringtone editors, calculators, calendars, and so on until now many kinds of applications can be used. This also cannot be separated from Apple's role in July

2008, which opened the iOS App Store as an application distribution platform and established standards for application distribution services [5]

Now more than 6.3 billion smartphone users worldwide spend most of their smartphone usage time on applications [8], [4]. In the current era of technological progress, apart from being used for personal life, it has also become one of the main tools in professional life by being applied in various fields. Among them are the fields of communication, travel [9], transportation [10], tourism [11], medical [12], insurance [13], consumer [14], high technology [15], energy [16] [17], public sector [18], and education [19]

In the transportation sector, the initial use of mobile applications was primarily for navigation and location-based services. In 2016, mobile applications were used for many transportation-related applications such as traffic safety, transportation emissions calculations, and vehicle navigation [20]. In other research, the application was assessed as being able to be used as a transportation inspection method. With the help of other technologies in the form of computer software, and cell phones, applications can collect information electronically which is connected to a reporting system thereby enabling more efficient inspection methods [21]. The use of applications in inspection is environmentally friendly because it can reduce paper usage [22]. On this basis, we developed an application for inspections in the transportation sector, especially inspections of facilities at airports.

Inspection in this study refers to activities that help maintain the function of facilities, check the condition of facilities regularly, and repair damaged facilities. Inspection and maintenance activities are very important, especially on pavement surfaces, because they are designed for aircraft taking off and landing at high speeds [23]. Facility inspections have two main objectives: (1) minimizing potential damage, and (2) repairing damaged facilities. As time progresses, the scope of facility maintenance also grows in proportion to the increase in facilities [24]

Mentawai Airport, the replacement airport for Rokot Airport inaugurated on October 20, 2023, was chosen as the location for application development research because it has new airport facilities compared to the old airport and still applies manual/ paper-based inspection methods. This provides challenges for more effective and efficient inspection activities.

This airport facilities inspection application is called the Airport Facilities Inspection Report (AFIR). There are 2 main contents in application design, namely airside facility inspection (FSU), and landside facility inspection (FSD). The contents of the airside facility inspection refer to the existing Mentawai Airport FSU inspection form. Inspection of landside facilities refers to PR 11 of 2023 concerning Guidelines for the Maintenance of Airport Landside Facilities on building finishing facility items [25]. Inspection applications are designed in the form of native apps that are compatible with the Android and iOS operating systems compared to web apps because native apps are considered more suitable and easier to use on mobile phones than web apps [26]

Application development uses the Appsheet program which is a fast and automatic multiplatform mobile application creation platform without coding or a little coding (low-code) [27]. Appsheet allows developers to develop applications using visual displays and without using specific coding languages. This will make it easier to create applications even if the developer does not have a programming background. Appsheet will collaborate with Google Sheets as a database and Google Drive as storage. The following is a picture of the relationship between AppSheet and Google Spreadsheet.

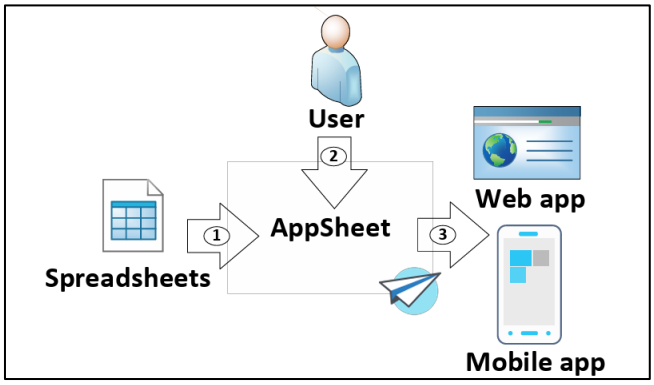


Figure 1 How Appsheet Works

The data captured by the mobile application (Google AppSheet) is stored in a Google Sheet which is also a database for further analysis and is on the right platform to be visualized in the application. All data collected and processed by AppSheet will later be collected on Google Drive. For data security, Appsheet facilitates users to customize data security [28]. For the AFIR application, users must log in to the Google account that has been registered by the admin so that not all accounts can access the AFIR application.

2 RESEARCH METHODS

In this research process, research and development methods and black box methods are used for application testing. Research and Development (R&D) research method is a research method used to produce certain products and test the effectiveness of these products [29]. One of the development models in this method is the 4D development method. According to Thiagarajan, 1974 in Marzuki et al., 2019, it consists of four stages of development. The first stage is to define (needs analysis), the second

stage is to design (conceptual framework), the third stage is to develop (development, validation, feasibility), and the fourth stage is to disseminate (implementation) [30] [31] [32]

At the application testing stage, the Black Box method is used often called Black Box testing. Black box testing is a stage used to test the smoothness of the program that has been created. This testing is important so that there are no errors in the flow of the program that has been created. Black box testing is testing software in terms of functional specifications without testing the design and program code." Another definition of Blackbox testing is a type of testing that treats software whose internal performance is unknown." Black Box Testing focuses on the functional specifications of the software, a collection of input conditions, and testing the program's functionality. [33] [34]

3 RESEARCH RESULT

Application modeling

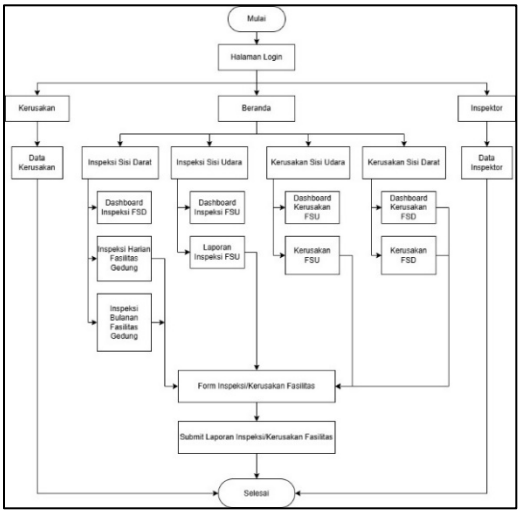


Figure 1 Application Modeling Flow Chart

The flowchart shows the application design in the form of 3 main menus, namely: home page, inspector, and damage.

Minimum hardware specifications

1. Android: Android device with at least Android operating system version 8 or above. Android versions 5 & 7 can still run applications but will not receive application updates.
2. iOS: iOS devices with a minimum of the iOS operating system version 11.0 or later
3. Desktop: all types of desktops that support use via browsers such as Google Chrome & Internet Explorer with a minimum version of 10.0.

AFIR Application Interface Display

1. Log In Page

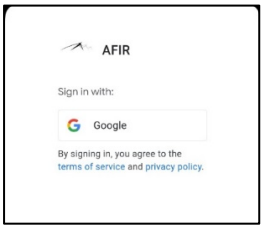


Figure 2 Log In Page

2. Home page

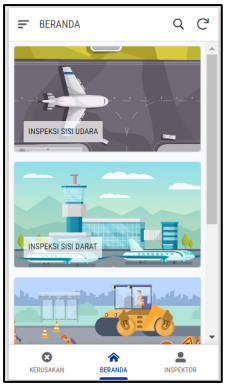
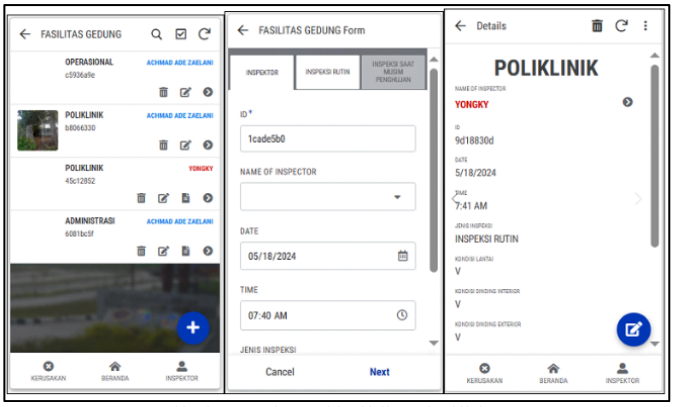
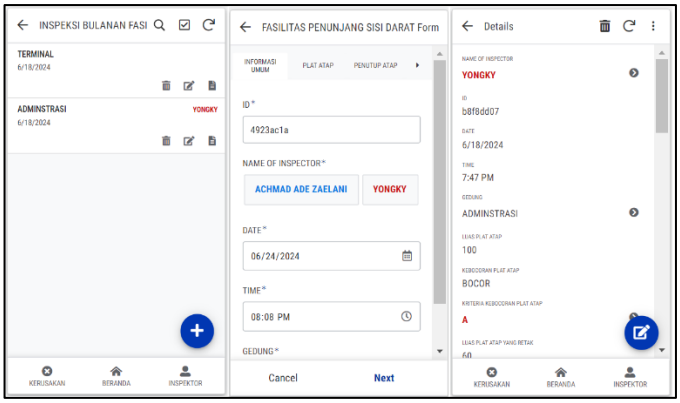


Figure 3 Home Page

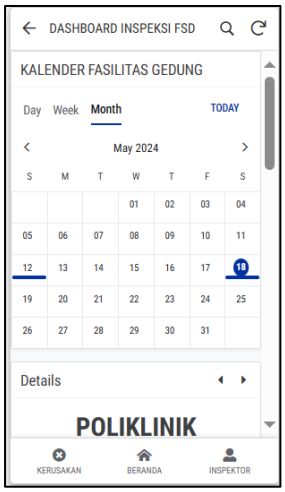
1) FSD inspection



(a) Daily inspection of building facilities



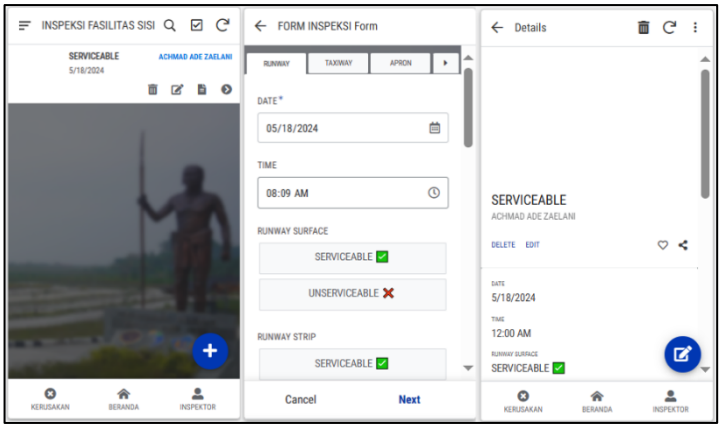
(b) Monthly inspection of building facilities



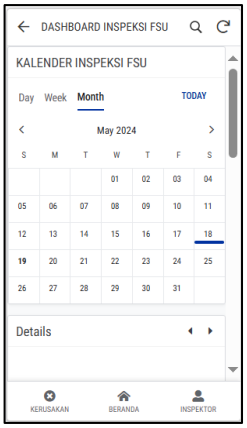
(c) FSD inspection dashboard

Figure 4 FSD Inspection Page

2) FSU inspection



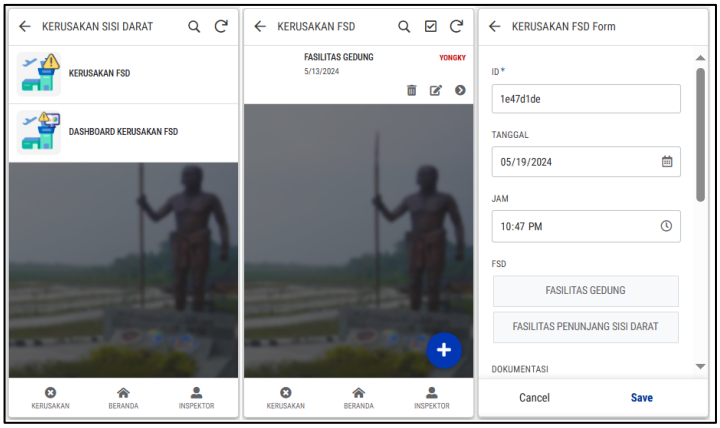
(a) FSU inspection



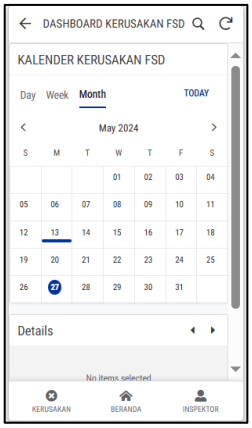
(b) FSU inspection dashboard

Figure 5 FSU Inspection Page

3) FSD damage



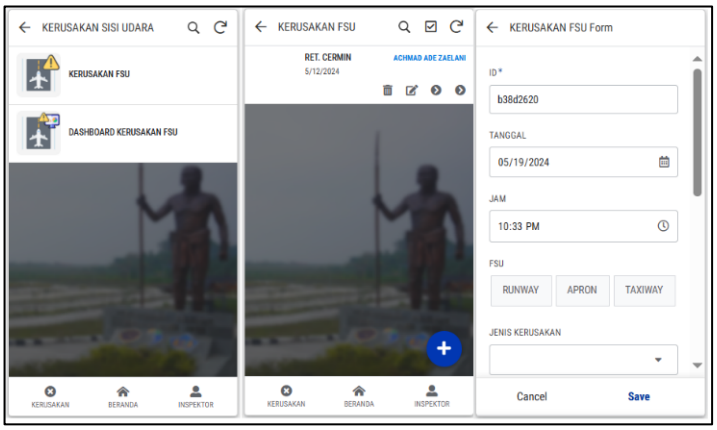
(a) FSD damage



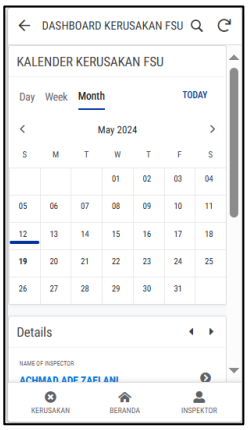
(b) FSD Damage Dashboard

Figure 6 FSD Damage Page

4) FSU damage



(a) FSU damage



(b) FSU Damage Dashboard

Figure 7 FSU Damage Page

3. Damage page

Figure 8 Damage page

4. Inspector page

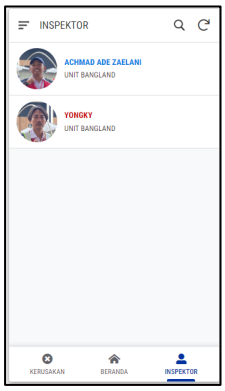


Figure 9 Inspector Page

5. Navigation drawer page

Figure 10 Navigation Drawer Page

AFIR Application Testing

Testing of the system being developed is carried out using the black box method which focuses on the functional specifications of the software.

Table 1 Black Box Testing of the AFIR Application

No	Testing	Test Scenarios	Expected results	Test Results
Log In Page				
1	The page opens	Displays the login page	Display the login page	Succeed
2	The log-in button is touched	Calling the home page	Displays the home page	Succeed
Home Page				

No	Testing	Test Scenarios	Expected results	Test Results
1	The home page opens	Displays the homepage view	Home page display	Succeed
2	The FSU inspection sub-menu button is touched	Call the FSU inspection page	Displays the FSU inspection page	Succeed
3	The FSD inspection sub-menu button is touched	Calls the FSD inspection page	Displays the FSD inspection page	Succeed
4	The FSU damage sub-menu button is touched	Calls the FSU crash page	Displays the FSU fault page	Succeed
5	The FSD damage sub-menu button is touched	Calls the FSD crash page	Displays the FSD damage page	Succeed
6	The back button is touched	Return to the home page	Displays the home page	Succeed
Damage Page				
1	The damage button is touched	Calls the crash page	Displays the damage page	Succeed
2	The damage page is shifted right/left	Move to another damage level page	Displays another damage level page	Succeed
Inspector Page				
1	The inspector button is touched	Switch to the inspector page	Displays the inspector page	Succeed
2	The inspector's name button is touched	Calls up the inspection history page	Displays the inspection history page	Succeed
Airside Facilities Inspection Page				
1	The airside facility inspection button is touched	Call the airside facility inspection page	Displays the airside facility inspection page	Succeed
2	The airside facility inspection button is touched	Calls up the airside facility inspection history page	Displays the airside facility inspection history page	Succeed
3	The airside facility inspection history button is touched	Calls up the inspection history details page	Displays a detailed inspection history page	Succeed
4	The add airside facility inspection button is touched	Call up the airside facility inspection form page	Displays the airside facility inspection form page	Succeed
5	The airside facility damage button is touched	Calls up the PMS survey history page	Displays the airside facility inspection page	Succeed
6	FSU inspection dashboard button	the FSU inspection dashboard page	Displays the FSU inspection dashboard page	Succeed
7	The back button is touched	Return to the airside facility inspection page	Displays the airside facility inspection page	Succeed
Landside Facilities Inspection Page				
1	The daily inspection button of building facilities is touched	Calls the daily inspection page of building facilities	Displays the daily inspection page of building facilities	Succeed
2	The daily inspection button of building facilities is touched	Calls up the daily inspection history page of building facilities	Displays the daily inspection history page of building facilities	Succeed
3	The building facility's daily inspection history button is touched	Calls up the inspection history details page	Displays a detailed inspection history page	Succeed
4	The add button for daily inspection of building facilities is touched	Call the daily building facilities inspection form page	Displays the daily inspection form page for building facilities	Succeed
5	The building facilities monthly inspection button is touched	Call the inspection page for monthly inspection of building facilities	Displays the monthly inspection inspection page of building facilities	Succeed
6	The building facilities monthly inspection button is touched	Calls up the monthly inspection history page of building facilities	Displays the monthly inspection history page of building facilities	Succeed
7	The monthly inspection history button of building facilities is touched	Call up the monthly inspection details page of building facilities	Displays a detailed page of the monthly inspection history of building facilities	Succeed
8	The add inspection button for monthly inspection of building facilities is touched	Call the building facilities monthly inspection inspection form page	Displays the monthly inspection form page for building facilities	Succeed

Table 2 AFIR Application Testing on Hardware

No	Smartphone Type	Operating system	Application/System Functions	Outcomes
1	Samsung Galaxy A52S 5G	Android 14	Goes well	Goes well
2	Samsung Galaxy J8 2018	Android 10	Goes well	Goes well
3.	Xiaomi Redmi Note 12	Android 13	Goes well	Goes well
4	Poco X3	Android 10	Goes well	Goes well
5	Apple iPhone 11	iOS 17	Goes well	Goes well
6	Lenovo Legion 5	Windows 10	Goes well	Goes well

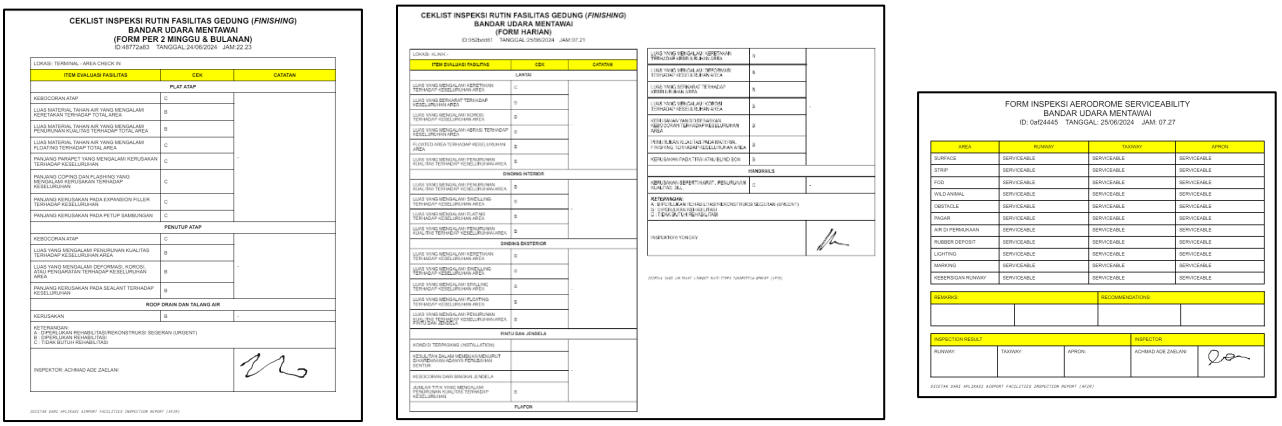
AFIR Application Security

The application can be used by downloading via email that has been sent to the user. Only users invited by the administrator can use the AFIR application. Users are required to log in via email that has previously been registered and invited by the

administrator. This avoids app activity from unknown users. Users only need to log in once to use the application and later when using it there is no need to log in again unless the user removes their account from the AFIR application.

AFIR Application Output

1. The inspection form document is in PDF format. On each FSU or FSD inspection filled in, the AFIR application will automatically change the results of the inspection into an inspection report document according to the existing format at Mentawai Airport.



(a) Monthly FSD Inspection Form (b) Daily FSD Inspection Form (c) FSU Inspection Form

Figure 11 AFIR Application Inspection Results Document Output

2. Documentation archive. Every user who includes documentation in the form of photos in a damage/inspection report will be saved in device storage or cloud storage.
3. Google Sheets. Any data entered will be automatically saved in a database in the form of Google Spreadsheet which can later be processed according to needs.

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