

DESIGN AND DEVELOPMENT OF AIRCRAFT MAINTENANCE MANUAL SMART READER AT POLITEKNIK BANTING SELANGOR

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Abstract

Department of Aircraft Maintenance, Politeknik Banting is a Civil Aviation Authority of Malaysia (CAAM) approved Aircraft Maintenance Training Organization and is a leading aviation maintenance Technical and Vocational Training (TVET) institution in Malaysia. Aircraft Maintenance Manual (AMM) is a document that contains all the procedures that have to follow during the mandatory maintenance of an aircraft which is stated as in ATA chapters. A manual developed by the manufacturer of a particular airplane that contains information necessary for the continued airworthiness of that airplane. For each type of aircraft there is different type of AMM. Aircraft Maintenance Manual is a vital document for maintenance personnel. AMM are available currently in hardcopies and softcopies but because of a lot of ATA chapters in AMM we have to scroll and search for the correct procedure during the maintenance and sometimes the maintenance personnel and students get confuse if they are not familiar with the maintenance manual. AMM Manual Smart Reader is actually to enable the aviation student and maintenance personnel to refer to Aircraft Maintenance Manual an easy and fast access to the maintenance task within the AMM when undergo inspection in aircraft. The AMM is developed with speech to text recognition and named Aircraft Maintenance Manual Smart Reader. The AMM smart reader was created by four software which is Framework 7, Adobe Phone Gap Build, Firebase and Cloud speed API. This application reduces the time taken to search on the maintenance manual and they can save their time when inspecting aircraft. Then, it also prevents the oil stains from contacting with the hardcopy of the maintenance manual when they use AMM smart reader. Currently the AMM Manual Smart Reader to be used by Politeknik Banting Selangor by students and lecturers for their workshop, laboratory practices and at the hangar for maintenance task.

Keywords: *Aircraft Maintenance Manual; ATA chapters; Smart Reader; Framework 7; Airworthiness.*

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Introduction

Aircraft maintenance operations is a highly regulated by the aviation authority and manufacturer to always ensure the airworthiness of the aircraft and have a clear traceability if the need ever rises. According to (Kinnison and Siddiqui, 2012) maintenance is continuous process to ensure that a system operates and perform its specific function at its design in level of reliability and safety. Various processes and documentations are utilized by aircraft maintenance organization that are performed by aircraft maintenance personnel in order to comply the requirements set by the regulations and ensure airworthiness of the aircraft prior flight. One of responsibilities of aircraft maintenance personnel is to be able to read and understand written documentations pertaining to aircraft maintenance (Safura Abdul Rahman, 2017). Still, the requirements regard to aircraft maintenance manual does not only applies to the maintenance organization but also applies towards maintenance training organizations too. Examples of requirements that are currently in place are as follows.

“The trainees also need to know not only the importance of using the maintenance manual but also to understand the language and structure of the documents. These manuals have elaborate arrangements, which must also be understood.” (International Civil Aviation Organization, 2003).

This is also specified by the Civil Aviation Authority of Malaysia for engineering trainee.

“The student must be able demonstrate the capability to use relevant tools/ equipment/ test equipment as specified by the tool/ equipment/ test equipment manufacturer and the usage of maintenance manual in that the student are able to perform the required inspection or testing without missing any discrepancies.” (Civil Aviation Authority of Malaysia, 2021).

A single aircraft usually requires multiples maintenance manuals that in its traditional paper-based format, can accommodate several shelves of storage and can be a rigorous task for upkeep and updating process especially if an organization has multiple aircraft types with different configurations. Because of this, maintenance and training operation has long started the utilization of electronic version of the manual, that can be access through a specific website provided by the manufacturer or in another digital format such as portable document format (PDF). Despite the changes of form, there are still limitations exist which will further be addressed in this paper.

Literature Review

There are 4 general categorization of aircraft documentations namely, manufacturer's documentation, regulation documents, in-house documents generated by operator or airlines and ATA standard documents (Harry Kinnison, 2012). Manufacturer's documentations consist of various documents given to the operator to maintain their aircraft. Example for such documents is Aircraft Maintenance Manual (AMM), Illustrated Parts Catalogue (IPC), Structural Repair Manual (SRM), Service Bulletins (SB) and Service Letters (SL). As for the Air Transport Association (ATA) standard document, it is a document specifically organized according to ATA100 chapter format, which systematically enables to reader of the manual to locate the chapter they need to find according to coded ATA chapter. In this paper, focus is

specific to Aircraft Maintenance Manual (AMM) in ATA 100-chapter format as it is one of the most commonly used documents for aircraft maintenance personnel because it provides specific instructions in order to perform various daily maintenance tasks. These manuals often containing copious amount of text, diagrams, various schematics as well as step-by-step troubleshooting guide (Wang Yu, 2014)

(Herimanana Zafiharimalala, 2014), has studied the usage of aircraft maintenance manual by aircraft maintenance personnel. The purpose of their study was to investigate and understand the usage of aircraft maintenance documents and find out the cause of non-compliance of procedures by aircraft maintenance personnel. Their findings indicates that aircraft maintenance personnel use maintenance manual thoroughly before, during and by the end of maintenance task. The purpose of referring to maintenance manual are:

1. To search specific information by manually going through the manual using skimming and extraction of specific information
2. To verify and check if there were any missing steps in maintenance procedures by intensive reading
3. To learn about a task or system specific of the aircraft by identifying through skimming and extracting only relevant important information from the maintenance documentation
4. To strictly comply with the procedure stated in the maintenance manual by performing intensive reading

They found that some of aircraft maintenance personnel decision to not fully complying to the manuals was not because it was intended to but rather unique circumstance of situation and configuration of the maintenance operation that had constrained their choice. Other factors stated in the study was the maintenance personnel level of knowledge of the maintenance procedures, the perception of the utility as well as the usability of the maintenance documentations provided to them as well any conflicted arise versus the needs of safety, legal implications and efficiency of the task.

Statement of the Problem

Regardless of the actual improvement due to change from paper-based AMM to digitalized format, it still doesn't fully address one of the fundamental problems exist that is finding specific maintenance procedures in the AMM. This is also mentioned by (Hobbs, 2008) that according to FAA, aircraft maintenance personnel spend around 25 to 40 per cent of their maintenance task duration dealing with maintenance documents. This problem is exacerbated by the lack of knowledge and experience especially in training school environments, whereby the students can easily be overwhelmed by the sheer complexity and amount of information they must go through in the AMM to understand prior a task. Moreover, as maintenance personnel performing their maintenance task, scrolling through the AMM with dirty, oily hands and especially if it is covered in gloves can be a nuisance. Then there's also limitations of paper-based manuals that are not durable and easily stained, even standard portable devices screen will have trouble registering touch inputs under such conditions. In addition, current digital PDF based AMM are also lacking in voice search capabilities as it is only limited to text-based searches.

Material and Methods

Aircraft maintenance manual (AMM) smart reader is an enhanced compact version of a maintenance manual, it is an android based application that can be installed into various personal portable devices. The AMM smart reader contains a portion of manual originating from Boeing 737-400 AMM, ATA chapter 09 taxing and towing and is specifically integrated with a speech to text recognition feature. This application is made aircraft maintenance personnel who are working with on the field and especially engineering student who are studying in an Aircraft Maintenance Training Organization. Therefore, they can improve their work efficiency by using AMM smart reader. This paper is aimed to develop a mobile application which helps personnel to find the specific maintenance task procedure in the AMM and reduce the time taken for task to be carried out.

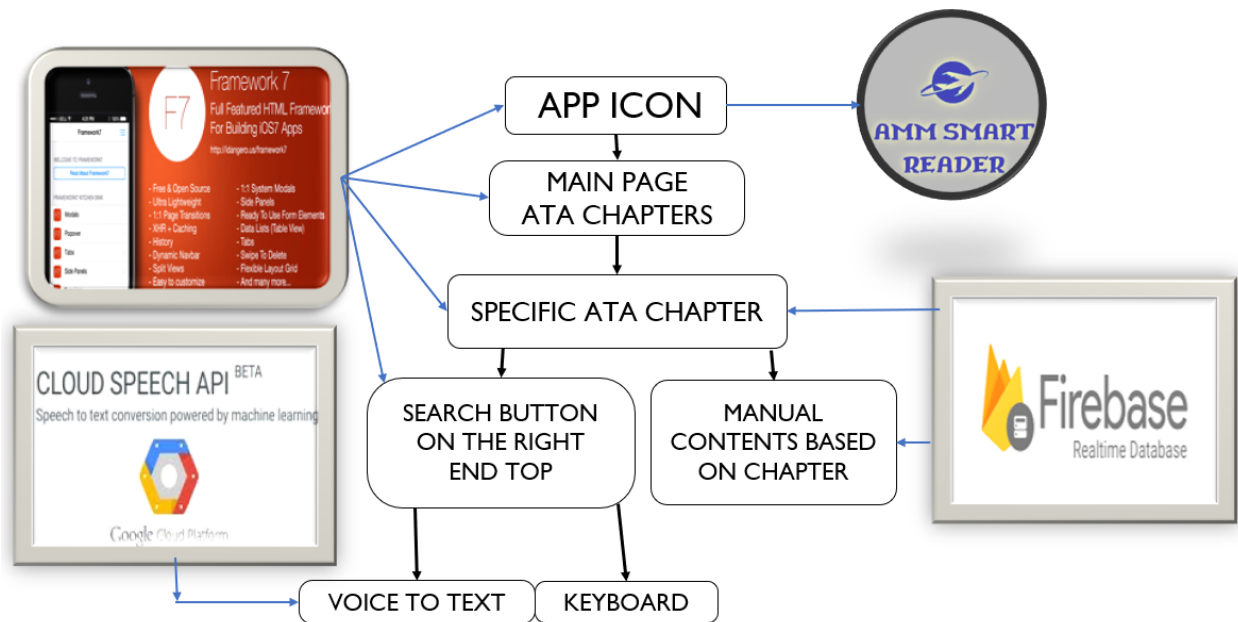


Figure 1: Application UI Design Process Flow and the application development software.

The initial steps taken to materialize the base application is by using Framework 7 studio. Framework 7 studio is the primary application generator software that were used in this development to create the base application. All of the user interface (UI) including front page of the application, placement of content tables and search bar were created using this software. It also allows application deployment to multiple devices without charges. The Cloud-base Speech to text application programming interface (API) was also integrated into the search function of the base application. The next software that was used is Adobe Phone Gap Build. Adobe Phone Gap is a standards-based, open-source development framework for building cross platform mobile apps with HTML, CSS and JavaScript for iOS, Android and Windows Phone 8. The side-line installation of the base application into the portable devices was performed using Adobe Phone Gap Build. As for the content integration of the application, Firebase was used as database. The Firebase Real-time Database allow the user to build applications by allowing secure access to the database directly from client-side code. This is the section which the portion of AMM Chapter 09 was installed into and becomes the primary content of the AMM smart reader.

Result and Conclusions

The base application was successfully created, along with the integration of Speech-to-Text search function and containing AMM ATA Chapter 09 as its main content.

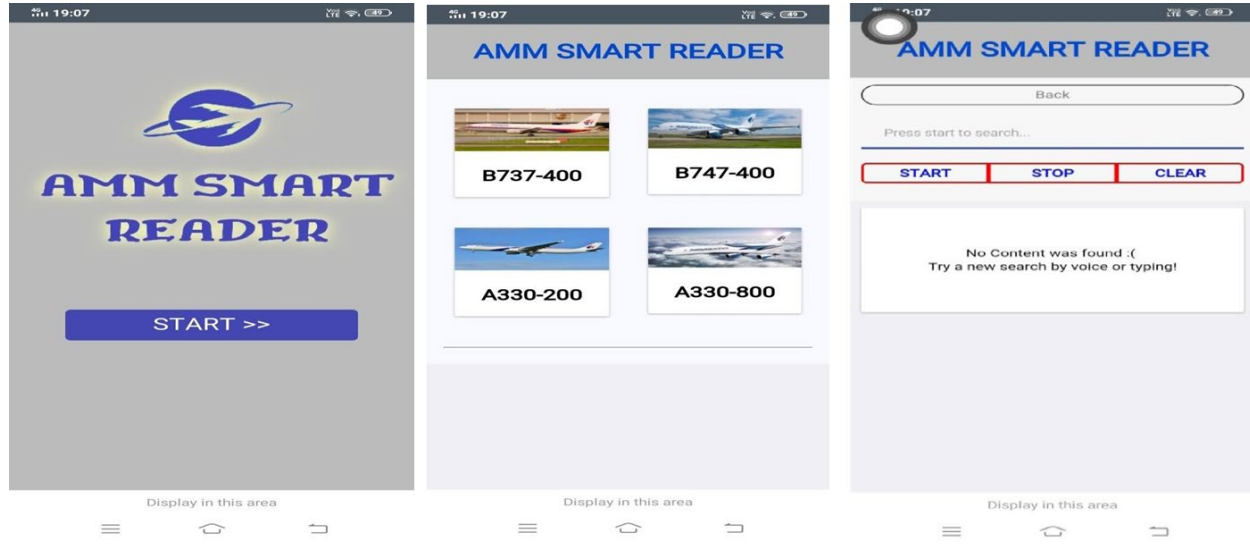


Figure 2: Front page of application, aircraft type category selection, search box and search results (from left to right).

The first figure starting from the left shows the actual front page of the AMM smart reader. User will have to click onto the main icon labelled “START” and it will proceed to its second page for further interaction. The second page on the center displays the AMM categories according to the aircraft type. The third page on the left displays the search boxes for maintenance procedures. There are four main buttons to operate the voice recognition system. The first button is ‘START’ button. When the user clicks on it, the application will start recording user’s voice. Then there is a “STOP” button. When the user clicks on that button the application will stop recording. And then there is a “CLEAR” button. This button will clear the searching content. The last there is a “BACK” button. It will bring back the user to the previous second page of the application.

Throughout the design and development of this application, it can be concluded that development of this application considered successful. The AMM smart reader manages to address the fundamental problems associated with finding information in the AMM via its integrated speech to text search box function. With its compact size, it is very portable, can be brought anywhere on the aircraft and free from limitations of traditional paper based manual formats. Even though the contents of the manual is only limited to ATA Chapter 09, additional contents covering more aspects of other aircraft systems can be implemented with an increase size of the smart reader Firebase’s database. The accuracy of the Speech-to-text application programming interface (API) can also be updated in the future to further improved in order to cover other aspects of smart reader menu navigation as well.

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