Development of Flexible Airline Reservation System using Quality Attributes for Domestic Airlines in Sri Lanka

SHIDN de Silva[1#], MTA Wickramasinghe[1] and D Gunasekera[1]

[1]*Department of Information Technology, Faculty of Computing, General Sir John Kotelawela Defence University, Rathmalana, Sri Lanka.*

[#] 36-it-0010@kdu.ac.lk

Abstract*: The airline industry is characterized by rapid change, innovation, and new technology. It is a fast-growing industry with annual revenues in the millions of dollars. From the up-sky, travellers could experience breath-taking views of Sri Lanka. So, using domestic airlines is the best way to travel in Sri Lanka. Therefore, local airline websites must be developed. However, there is fierce rivalry in the airline industry because everyone is striving to be the best to gain their market share through various strategies such as offering excellent customer service, low-cost fares, and other perks for travellers. To accomplish those tasks, the researchers identified the importance of developing a web application through an investigation. Researchers identified the challenges faced by the flight seekers and administrators of the airlines through many problem identification techniques. Functionalities that will be supported to improve the efficiency of the domestic airline reservation system were authorizing an administrator to manage all the passenger details and flight details, developing a more secure system, automating the e-ticket generating system, improving user satisfaction by enhancing the user experience, reducing the developing and maintenance cost, encourage the users who have a low level of computer literacy to use the system. So, the researchers' main aim was to develop the application by enhancing the above-mentioned functionalities. For that researchers decided to use features such as tokenization, bar code generators, report generators, and automated ticket generators. After the successful development researchers have done a system test by contributing domestic airline users. Through the analysis of testing results, all respondents have been satisfied with the successful development of the domestic airline reservation system.*

Keywords: *Domestic Airline Reservation, Flight-Booking, Web-Application*

1. Introduction

Air traveling is the easiest and most efficient way to travel inside the country since the local roads may take much time even though it is cheap. Developers hope to create a domestic airline reservation system for Sri Lanka. A domestic flight is a flight that departs from and returns to the same country. Tourism is one of the main sources of income in Sri Lanka. Today, the tourism industry of Sri Lanka is developing, foreign tourists like to experience the beauty of nature, explore ancient cities, and spend their time with their favourite activities. Hence, travellers will need to travel across the country quickly and easily without any hesitations. The airline reservation system project is an implementation for an airline ticketing website. The airline reservation system project is for the domestic airline ticketing website. Airline organizations arranged flights on a low budget for tourists since the demand is still very low. As a result, such organizations do not make a big profit. That is the main reason they could not afford web systems which cost a lot. And the researcher found that there are some challenges faced by the users of domestic airline reservation systems. Identified challenges of existing systems were dissatisfaction with the user interfaces, need for better computer literacy and operational handling, un-secure flight bookings and payment transactions, and the inability of generating an e-ticket. Therefore, researchers aim is to design and develop a domestic airline reservation system that can overcome the above-mentioned challenges. The main objectives of the research are to understand the problems in existing and current systems and implement a more efficient domestic airline reservation system that can achieve the aim, then test it by giving it to experienced users and evaluate the test results and conclude.

2. Literature Review

Since researchers wanted to get more knowledge in this area to fine-tune our objectives, researchers decided to refer to some profuse research papers. When researchers refer to the projects and the research papers available on the internet which are based on Airline Reservation Systems, there are particularly important factors for us to know about existing systems in this field. We were able to get a clear idea about how they developed those systems and what are the technologies that they have used. So below is a clear summary of the research papers that were referred by researchers for designing our airline reservation system.

According to the "An Overview of NLIDB Approaches and Implementation for Airline Reservation System" by Mony, Rao, and Potey (2014) this research is to compare the approaches of Natural Language Interfaces for Databases (NLIDB). Also, to examine the advantages and disadvantages of NLIDB. And, finally to implement an approach for a flight reservation database. NLIDBs are systems that convert natural language sentences into database queries. These systems allow users to interact with the databases directly by entering the commands in natural language. The Intermediate Query Approach makes it simple to map identified concepts to an intermediate representation. And when developing the system, they used Java, Spring framework, and MySQL databases. After

developing the software, the software is tested by running natural language queries and retrieving the results. Authors have mentioned that the NLIDBs' future scope could be focused on obtaining domain independence.

Presented paper under the topic of “Development of a Mobile Airline Reservation Application” by Alo et al. (2012) focus on developing a mobile application for air ticket bookings anywhere, anytime and saves cost and time because mobile applications are becoming more and more common in people’s daily lives. Here, researchers have discussed the software architectural design of the proposed mobile airline reservation system. The main function of the system is to make the process of booking a flight a simple and trustworthy manner. Because traditional reservation records have many drawbacks like incomplete, misplaced, or loss of records. Furthermore, the systems produced by foreign countries are very expensive to use. And the mobile airline reservation system application was developed using Xcode for software design on iPhones and Java for the development on BlackBerry phones. C#.Net is used for the front-end and SQL server is used for the back-end.

The paper “Investigating the factors influencing users’ continuance intentions towards online reservation” by Mouakket, (2013) helped us to get the idea of how to build a system that can keep their customers using these online websites continually. This research shows the roles of hedonic value and subjective norms in motivative continuance intentions towards using online reservation systems. In this paper, they posit that the expectations of people who are important to a customer, such as relatives and colleagues, influence their continuance intentions towards using an online reservation. Thus, the following hypothesis is formulated: H6: Subjective norms have a positive influence on continuance intentions. After analysing the data gathered the study has found that hedonic value within the online reservation context, is consistent with previous studies in web-based applications. And the findings conclude that while utilitarian value positively influences satisfaction, hedonic value has not shown a positive relationship with satisfaction for online reservation customers. And, that satisfaction, usefulness, and subjective norms are important factors when motivating customers' continuance.

“The case study on airline reservation” by Williams et al (2020) discusses their developed framework to demonstrate how the idea of web services can be utilized for online airline reservations by using the finite automata computational model. This model is a fundamental computing model that presents sufficient behaviour of the service based on its user consideration. In this paper, the researcher has tested two types of finite automated models as; Deterministic Finite Automata (DFA) and Nondeterministic Finite Automata (NFA).

These are tested with the JFLAP simulation tool to measure the effectiveness and efficiency of online airline reservation optimization. Researchers have proved how NFA and DFA can be used to indicate the transition flow of an online airline reservation with the given simulating input. The finite automata are an advantageous technique in web service testing and can confirm the test suite used in the study.

The research “Issues with flexibility: A reason for not using online reservation systems?” by Mushtaq, Loviscach, and Sulaiman (2010) says the results indicate that flexibility, rather than functional requirements, has a substantial impact on the perceived usefulness of online reservation systems. Using an online reservation system to book a ticket typically results in lower transaction fees. This research is based on a survey questionnaire that was issued to airline passengers. To test the model and the above hypotheses, a questionnaire was created. The incorporation of flexibility has a considerable impact on the usability of online reservation systems. Secondly, relationships between functional requirements and online system usability are thought to have a minor effect on each other.

The paper by Ele, Agana, and Bukie (2018) “A Distributed Airline Reservation System for Nigerian Airline Companies” focused on the development of a distributed airline reservation system and resolving problems of the current reservation systems. For their flights, airlines have also set up a distributed reservation system.

Each airline had a system, that was not connected to other airlines or ticket agents. This technology is used to handle airline bookings and connects with a global distribution system (GDS), which allows travel agencies and other distribution channels to make a reservation for most major airlines in one place.

Mushtaq and Riaz (2016) presented a paper on the topic of “Flexible Airlines Reservation Systems Using Service Quality Attributes of Airlines”. According to the authors, the scope of this research is to examine the flexible behaviour of travellers to design an online airline. With a more flexible reservation system. The flexible behaviour of the users is examined from the perspective of cognitive psychology. And Human-Computer Interaction (HCI) explains the interaction between humans and computer technology. To explain human behaviour, HCI has deployed many theories, principles, and concepts such as Perception, Memory, Language, and Thinking. According to the research paper, having a clear understanding of user behaviour will help web designers to develop websites flexibly and effectively. Furthermore, travellers’ desire for affordable prices is a major consideration when developing a flexible system. This study is based on a survey questionnaire that was issued to airline passengers. And, to determine external variables’ association with flexible behaviour of travellers, has used Pearson Correlation Coefficients and Multiple Regression Analysis. The results obtained using Pearson Correlation Coefficients of quality service are statistically significant. And Multiple Regression Analysis shows the relationship between service quality attributes of airlines, external variables, and flexible behaviour of travellers. Finally, the paper implies

that the usability of the website cannot be improved without considering customer intent and user behaviour.

Law and Leung (2000) presented a paper on the topic of "A Study of Airlines' Online Reservation Services on the Internet". Researchers say that making travel plans via the Internet is the second-largest commercial segment on the Internet. According to the authors, the main goal of this research paper is to investigate airline online reservation services and the benefits offered to clients who use the internet. In the paper, it has shown that many people access the Internet to get flight information and make reservations. In the paper, the authors have mentioned that there should be an online catalogue that gives all the data a customer requires to make a buying choice such as air ticket price, schedules, flight availability, and updated contact numbers for making reservations. And also, the efficiency of an online reservation system in terms of processing time is an important aspect that draws travellers to purchase air tickets online. If the web page contains a lot of graphical images, then it will take a long time to load the page. So, web designers should aim to avoid putting substantial content on the main page and instead keep it simple with links to linked sites. Here, researchers have observed what are the things that should be changed, what things should be included, and what are the qualities and services of an airline reservation system. These reservation services were categorized into flight schedules and availability, air prices, and online ordering information. At the end of the research, results showed that the most comprehensive airline Web sites were in the North American region. Furthermore, the results of this study demonstrate that credit cards were the only method of payment for online air ticket purchases. Finally, the purpose of this study was to examine the essential features and benefits offered by airline websites to their clients.

3. Methodology

With the recent evidence of the researcher, the research philosophy of this research is to develop an airline reservation system by enhancing the maintenance efficiency and decreasing the cost while increasing the user interaction with the system. The researcher has gone through the hypothesis of developing an easy, reliable, and well-secured system for users. It also aims to create a system that can be easily maintained by small organizations. So, the researcher has used the deductive approach while implementing this system.

The researcher intended to carry out some research strategies through both qualitative and quantitative methodologies. A survey is a method that the researcher used to collect rich and reliable data. The survey was passed among the people who are in groups on WhatsApp & Facebook which are based-on flights. Case studies focused on the background area of airline reservations. For this research cross-sectional time frame was used by the researcher. As the proposed system is going to develop for the Domestic Airlines in Sri Lanka via the sample population consisting of the main users as Passengers, Viewers, and Admin. With the support of those actors, the data collection process was done through Questionnaires and Interviews.

A. Questionnaires

The questionnaire was distributed through two main sections as Aviator Section and Passenger Section. The researcher gave different questions to each section. A questionnaire was provided to the aviators like Pilots, Student Pilots, Aviation managers, and Administrators of Airlines. And the questionnaire was passed among the passengers who are in groups on WhatsApp & Facebook which discuss flights.

B. Interviews

Since there were a lot of users of this system, the researcher decided to interview only the main administrator (Director Operations) of this system as he shall be maintained and manage all these data. The researcher understands the expectations and the requirements of the administrator using the interview.

With the evaluation of both questionnaire and the interviews, the researcher identified the necessity of an online airline reservation system, the pros, and cons of the current applications, challenges faced by the users, and factors to be considered to increase the support of managing the system, the important functions which need to be included in the proposed system.

By examining all those data researchers came up with a conclusion of proposing a new airline reservation system.

4. Proposed System

The following diagram illustrates a simple conceptual diagram that elaborates the concept of implementing an online airline reservation system.

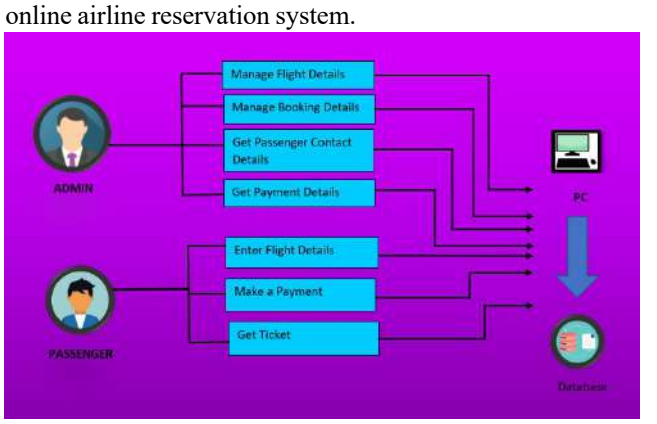

Figure 1. Proposed System Architecture

There is only one main login interface in this system for admin. This proposed system can be accessed by the administrator, operation staff, and passengers. Furthermore, each administrator and operational staff have a unique username and password provided by the system when they register. Passengers have the ability to access the system without registering for the system. There are major functional requirements are listed below.

Administrators are able to,

- Add flight details (chartered/ scheduled)
- Remove flight details
- Update flight schedules

- Add another administrator
- Add reservations
- View passenger details, edit & delete details
- View payment details
- Inform flight cancellations
- Add/ Update Gallery
- Manage inquiries
- Add Promotions

Passengers are able to,

- View flight details (Chartered/ Scheduled)
- Book flights
- View Gallery
- Get promotions
- Make inquiries
- Make payments
- Get E-tickets

5. Implementation

A. *Login Module*

The system comprises one login interface which is only used for administrators to access the admin panel. The distinctive feature of this system beyond the other existing system is passengers do not need to create an account to make use of the functions of the system. The reason for adding this functionality is because that customer does not use domestic flights frequently in their day-to-day activities according to the analysis investigation done by the researcher. The only administrator has the ability to give access to other airline admins to the system.

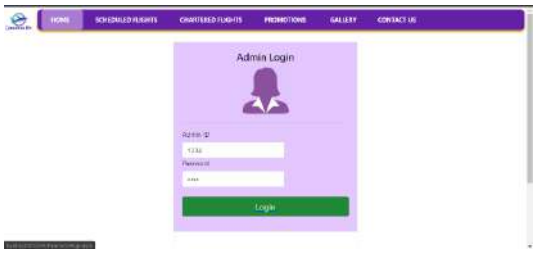

Figure 2. Admin login interface

B. *Flight Details Module*

Most existing systems in SL are still using the hard-coded systems without the contribution of the admin panel. The importance of this system is having an admin panel that has CRUD operation functionality which deducted the need for hard coding the details to the system. Here, the administrator has the authority of handling both chartered and scheduled flights.

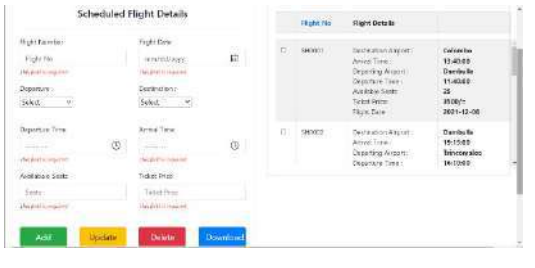

Figure 3. Admin panel of scheduled flight details interface

The user has the below-mentioned interface to check the scheduled/charted flight details. Then they can explore through the booking.

Figure 4. The user interface for scheduled flight details

C. *Flight Booking Details Module*

This module allows administrators to add new flight booking details and update/ delete those details. And especially he/she has the ability to download the passenger details of the booking. The significance of this functionality is it improves the efficiency of storing and sharing booking details of flights.

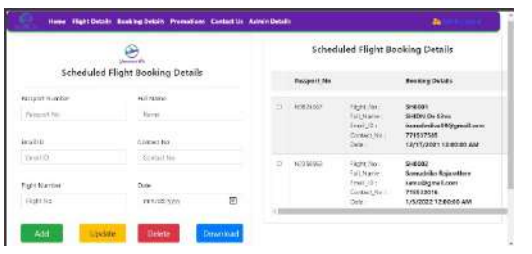

Figure 5. The user interface for users Flight booking details

D. *Promotion Details Module*

The promotion details module helps to enforce the customer interaction with the application and use this for their flight bookings. Enhancing customer satisfaction will encourage to increase in the profit of the airline company. The administrator has the authority of promotion management.

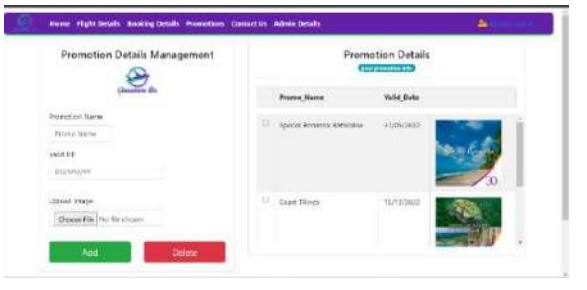

Figure 6. Admin panel of promotion details

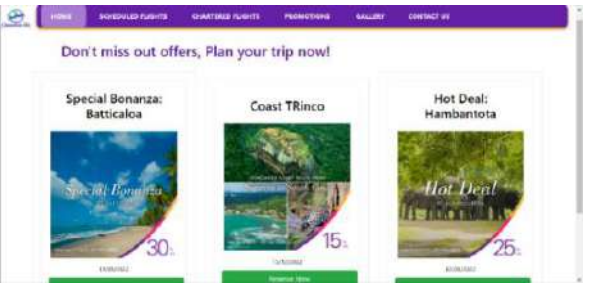

Figure 7. The user interface of promotion details

E. *Contact Details Module*

If a user has inquiries about flight details, he/ she has the ability to use the contact us module. Then, the administrator receives the inquiries of the user. So, the administrator can download and manage the requested details.

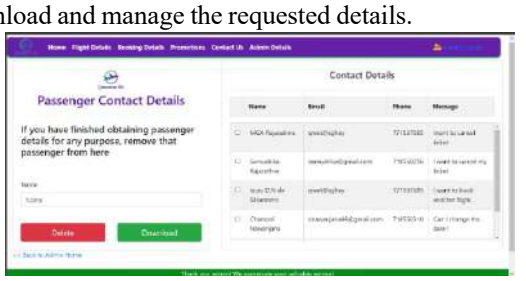

Figure 8. The admin interface of contact details

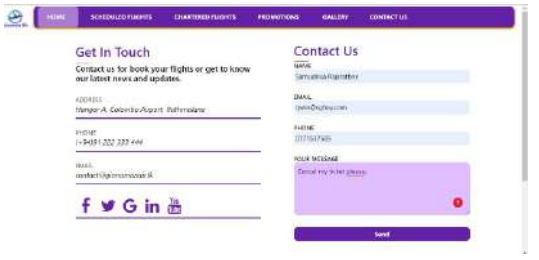

Figure 9. The user interface for contact details

F. *Payment Module*

After choosing the suitable flight, user can enter their required details to move to the payment interface.

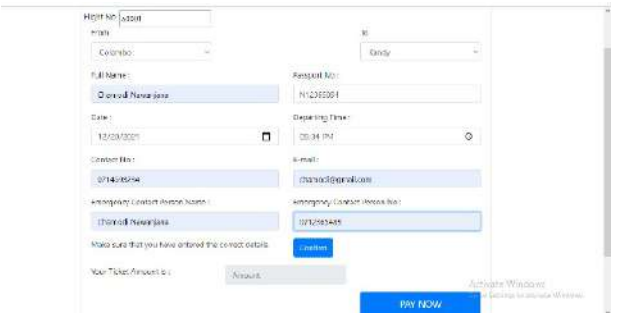

Figure 10. Payment details interface

User has the potential to use the preferred payment method to purchase their flight ticket.

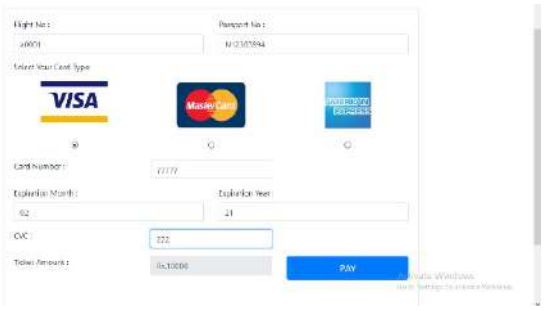

Figure 11. Payment module interface

G. *Flight Ticket Module*

After the successful payment, an electronic ticket receipt will be generated automatically. Then the user can save it to their devices' local storage.

Figure 12. Generated E-Ticket

H. *System Requirements*

The system architecture used to develop this system is a layered architecture. When it comes to the project's overall technical architecture, mainly researchers used the Visual Studio 2017 ASP.NET framework with C# as the main programming language. To design the user interfaces of the web application researchers have used HTML and the bootstrap framework. Microsoft SQL is an open-source database that provides comprehensive support for this kind of application development needs. Hence, the developers used Microsoft SQL as their database.

I. *Technical Feature Extraction*

Another novelty of developing this system was the proper usage of a combination of features to overcome the challenges identified. Given below are some novel features that the developer has used when developing this system.

Users place high importance on data security since the services' related data are stored on remote platform servers, which are located outside of their physical location. It is important to provide a protected environment for the client's commercial and personal data. As the clients use their card details to make their payments through our payment gateway there is a risk of hacking the card details. To avoid that researchers have used token API which is having high restrictions on authentication. The researcher has used tokenization that will be more supported for the .NET framework.

To increase the efficiency of this system, report generators are used. Because report generators will ease the task of managing the passenger and flight booking details. As this is a C#.Net framework-based application, the developer has used Aspose document API which is feature rich and powerful. And also, it supports all popular loading and saving formats.

Generating an e-ticket is one of the main features applied to this domestic airline reservation system. So, applying a bar code to this will prohibits anybody with fake, duplicated tickets from entering. The developer found that the BarCode NuGet package library for C#.NET will be more supportable for the barcode generator in this system. Also in this system design, there is no need for third-party services for paying a subscription fee. All the required functionalities are built-in to the system by the developers. That will cause a reduction in the total cost of the development.

6. Testing and Evaluation

Before sending out to the outside testers, developers have to evaluate the system by using some testing methods. Such as unit testing and integration testing. The researcher used the acceptance testing (beta test) to get the contribution of involving the external parties to evaluate this system. To evaluate this system researcher got the contribution of two parties. Those parties were airline administrators & flight seekers. Through the management process of certain modules, the system's features are evaluated as modules.

A. *Evaluation of administrator*

And researcher has taken the contribution of Sri Lankan domestic airline companies to evaluate this system. After the testing procedure conducted by administrators, they have given their overall final opinion of this newly designed system. The pie chart below shows the percentage of preferences for this system.

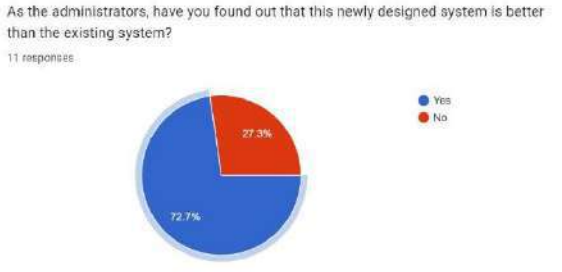

Figure 13. Administrator opinion analysis

This chart shows that a high percentage (72.7%) of administrators have suggested this as a better application for managing their daily tasks.

But some of them do not give a good reaction to the performance of this system. They have suggested some functionalities to be modified in this system. Those are:

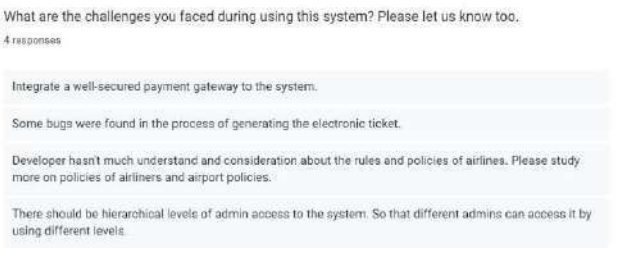

Figure 14. Suggestions of the Administrators

B. *Evaluation of flight seekers*

In addition, the system efficiency was evaluated using 57 flight seekers. The researcher has given this system to colleagues, relations, and neighbours who are using frequently using reservation systems.

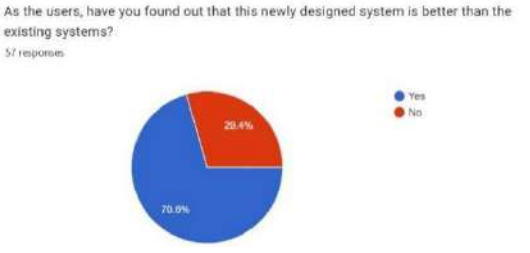

Figure 15. User opinion analysis

Most of the respondents (70.6%) agreed with this system. So, they understand that this will overcome the problems in the existing airline reservation systems.

Some users found some problems with this system. So that they have put "No" as their answer to the above question. Then some of them have suggested some areas to improve in this system. Those are:

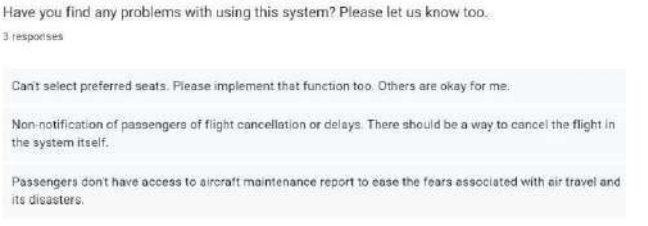

Figure 16. Suggestions of the flight users

7. Conclusion

This automated domestic airline reservation system provides a successful, effective, and efficient way for users and administrators. The key purpose of the implementation is to check whether the developed system is fulfilled the user requirement and confirms the test results expected under a wide range of conditions. To accomplish this flight reservation process easier, the researcher applied a web-based online flight reservation system as it will be able to address the real problem encountered by the user with the existing system. The significance of this reservation system is reducing various costs (especially maintenance costs), time-wasting which is going to the agency or office, decreasing the paperwork, and helping in easier record maintenance by having a centralized database system. The user can book a flight from anywhere within a short period. The web system provides a quick and reliable process hence reducing the load of work done manually and saving time for both user and admin. From the system, it replaces a load of paper works such as ticket printing, and document printing to a few computers. Therefore, the system will be a solution for minimizing resource wastage. The identified solutions provide many direct and indirect solutions to the airliners via this system.

8. Further Works & Recommendations

The researcher indicates some suggestions for improving the coherence of the system by adding the functionality of accurate seat reservation, automated flight cancellation process, agent communication process through chatbots, and process review system. These functionalities will take a prominent place in improving the efficiency of the airline reservation system.

References

Ele, B. I., Agana, M. A., & Bukie, P. T. (2018). A distributed airline reservation system for Nigerian airline companies. Compusoft, 7(6), 2766–2772. https://doi.org/10.6084/ijact.v7i6.721

Law, R., & Leung, R. (2000). A study of airlines' online reservation services on the internet. Journal of Travel Research, 39(2), 202–211. https://doi.org/10.1177/004728750003900210

Mony, M., M. Rao, J., & M. Potey, M. (2014). An Overview of NLIDB Approaches and Implementation for Airline Reservation System. International Journal of Computer Applications, 107(5), 36–41. https://doi.org/10.5120/18750-0006

Mouakket, S. (2013). Investigating the factors influencing users' continuance intentions towards online reservation. 2013 International Conference on Computer, Information and Telecommunication Systems, CITS 2013. https://doi.org/10.1109/CITS.2013.6705709

Mushtaq, A., Sulaiman, S., & Loviscach, J. (2010). Flexibility issues: A reason for not using online reservation systems? Proceedings 2010 International Symposium on Information Technology - System Development and Application and Knowledge Society, ITSim'10, 3(July), 1076–1081. https://doi.org/10.1109/ITSIM.2010.5561615

Williams, T. B., Rahiman, A. R. A., & Joseph, I. (2020). Web service-based automata testing: A case study on online airline reservation. 2020 International Conference on Computer Science and Its Application in Agriculture, ICOSICA 2020. https://doi.org/10.1109/ICOSICA49951.2020.9243269

Author Biography

SHIDN de Silva is a 3rd year Information Technology Undergraduate of Faculty of Computing, General Sir John Kotelawala Defence University.

MTA Wickramasinghe is a 4th year Information Technology Undergraduate of Faculty of Computing, General Sir John Kotelawala Defence University.

Mrs. D Gunasekera is currently Lecturer (Probationary) at Department of Information Technology, Faculty of Computing at General Sir John Kotelawala Defence University.