

Identification of Common Sitting Postures of Aircraft Passengers through Observation Method

Fairuz I Romli, Negin Ozve Aminian, Norfara Aiza Hamzah

Abstract: Passenger comfort is an important feature that can increase the competitiveness of flight services of an airline against its market competitors. The aircraft seat design plays a big role in promoting comfort for aircraft passengers, especially in relation to the sitting postures that it can support. In order to conduct the ergonomics assessment on the seat design, the sitting postures of the aircraft passengers have to be established. This study aims to identify some of common sitting postures of the flying passengers inside the aircraft cabin by means of the observation method. 10 volunteers are recruited and they are individually recorded while sitting on a representative aircraft seat for about an hour. Based on the obtained recordings, common postures have been identified based on their frequency of occurrence among the volunteers. All in all, eight common sitting postures have been identified and they can be used in the posture analysis.

Index Terms: aircraft passengers, ergonomics, observation method, sitting postures.

I. INTRODUCTION

Today, the market environment of the airlines industry is highly competitive, especially with the growing success of the low-cost airlines. Hence the airlines have to differentiate their offered flight services against their market competitors such that they are able to attract potential passengers. Many aircraft passengers consider seat comfort as one of the primary factors in their choice of flight services [1]. Based on this realization, it is not surprising that many airlines are using aircraft seats on their fleet as one of marketing strategies to distinguish their services [2]. However, comfort is not simply the absence of discomfort because it can be also associated with the pain and biomechanical factors, as well as relaxation, luxury and also well-being [3]. Even though reducing experienced discomfort level will not necessarily increase the level of comfort for the passengers, it does need to be low to accomplish a high level of comfort [4]. It seems that the comfort level will peak when the expectation of passengers is exceeded (maximum comfort) and they are satisfied with the experience [5].

To attract the passengers, the aircraft seat design should be able to suitably accommodate them inside the cabin during the entire flight duration. An aspect of the comfort or discomfort perceptions is the postural comfort, which is the measure of the level of well-being as perceived by humans when they are interacting with their environment [6]. In the context of this study, it is the perception of passengers while they are sitting at their seat during the flight. Good seating

enables significant changes in position and the design of the seat does not restrict the movements to the postures commonly seen for the tasks or activities [7]. This relates to body postures whereby the seats should account for the anthropometric variables and activities that the passengers frequently do while onboard the aircraft [8]. Based on these common postures, ergonomic analysis can be conducted to aid in reducing any potential musculoskeletal symptom and discomfort [9]. The identification of common sitting postures for aircraft passengers during flight has to be made before the postural analysis can be conducted. Early methods of recording the human postures have been conducted through drawing or photograph and supplementary descriptions, which are called pen-and-paper-based methods [10]. With the continued progress of new technology, several observational methods that involve computer-aided tools and videotaping have been developed. The pen-and-paper-based, and computer-aided and videotaping observational methods have been discussed in details by Li and Buckle (1999) in [11]. A published study related to sitting posture analysis is using optoelectronic system for motion capture [12] whereas video analysis and Portable Ergonomics Observation (PEO) method are applied in another study [13]. Moreover, a study on train seat design through observation of sitting behavior has been conducted using the rapid coding method and time-lapse films [14]. On the whole, there are many methods with utilization of different assisting technology that can be applied for posture observation. For this research study, the primary objective is to establish several common sitting postures of aircraft passengers. These postures are useful for future posture analysis in ergonomics design assessment of aircraft seat such as Rapid Upper Limb Assessment (RULA) [15]. Observation of the volunteered test subjects has been done to monitor their sitting behavior and frequent occurrences of certain observed postures are taken to signify that they are typical postures for the particular aircraft seat used [14].

II. METHODOLOGY

For this study, 10 participants between the age of 20 to 30 years old are recruited on voluntary basis. They are observed for a duration of about an hour while seated on the reference aircraft seat that has been arranged to replicate typical aircraft cabin of current commercial transport aircraft. The reference aircraft seats used in this study are available at the laboratory of Department of Mechanical & Manufacturing Engineering Department, Universiti Putra Malaysia and they are shown in

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Fig. 1. The seat pitch used is roughly 737 mm, which is the common value used by many low-cost airlines. Although the seat pitch can vary between airlines that implement similar seat design and this affects possible sitting postures of the passengers, the value used is taken as a conservative measure.

The observations have been recorded using Canon digital camera and the designated observer is positioned at the best spot to view the subject. Each of the test subjects is observed individually and they have been instructed to sit freely on the aircraft seat as if they are on the actual flight throughout the duration of the observation period. After the observation has ended, the recording is analyzed to identify prominent sitting postures for each of the test subjects. These postures are then compared with the ones recorded for the other test subjects and postures that frequently occurred among them are taken as the common sitting postures for the aircraft seat. All in all, the steps of the methodology that have been followed in this study are summarized in Fig. 2.



Fig. 1: The reference aircraft seats used in this study

III. RESULTS AND DISCUSSION

Overall, a total of 10 volunteers have been recruited for this study and the recording time of the sitting session is an hour for each test subject. Based on the recordings, eight common sitting postures are identified in accordance to their frequency of occurrence by the volunteers as a whole. These identified common sitting postures are illustrated in Fig. 3 while a short description for each of them is tabulated in Table 1.

The identified sitting postures may be used to represent the common postures of seated passengers in the aircraft cabin for posture analysis. The postures can be appropriately modeled using the computer-aided analysis tools for this purpose. For example, the modeling for postures 2 and 3 is illustrated in Fig. 4. The models have been constructed using JACK ergonomics analysis software with the human model made by applying the anthropometry data of Malaysians.

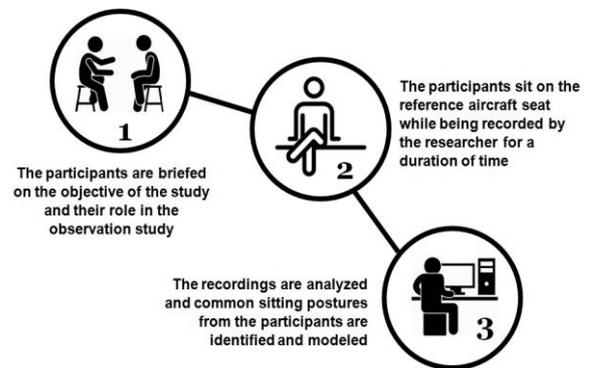


Fig. 2: Methodology followed in this study

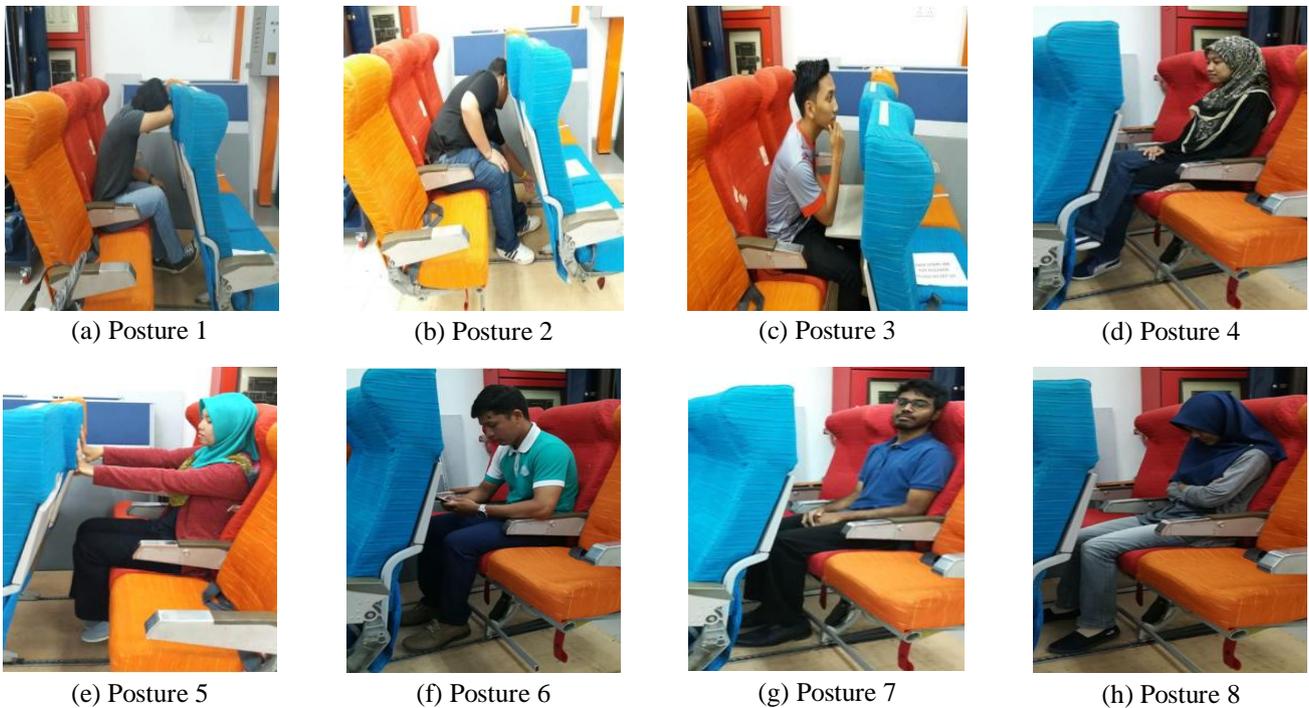


Fig. 3: Observed sitting postures of the volunteers

Table 1: Description of observed common sitting postures

Posture Label	Brief Description
1	The passenger's trunk is bent forward to place the head on the back of the front seat.
2	The passenger's trunk and head are bent near the ground with the right hand is stretched to reach something on the ground.
3	The passenger's left elbow is placed on the tray and the right elbow is on the right armrest of the seat.
4	The passenger is sitting up straight with both hands on the lap and the legs are crossed, looking at the screen at the back of the front seat.
5	The passenger's hands are both stretched to the back of the front seat while sitting up straight.
6	The passenger's trunk is bent forward and the head is looking down at the gadget held in hands.
7	The passenger's body is fully rested on the seat with both hands on the lap.
8	The passenger's head is looking down and both hands wrapped around the body while the body is fully rested on the seat.



(a) Model of posture 2



(b) Model of posture 3

Fig. 4: Example modeling of the sitting postures in JACK

IV. CONCLUSION

Ergonomics analysis of aircraft seat can be conducted to establish the level of passengers' comfort while sitting inside the cabin during flight. In order to do this, the common sitting postures of the passengers have to be established first. In this study, 10 voluntary participants have been recruited and their body postures have been observed while they are seated on the reference aircraft seat for about an hour session. All in all, eight different passenger sitting postures have been identified as common from the recorded sessions. These postures can be modeled using computer-aided tools to be applied in posture analysis study as illustrated by the models made using JACK software tool.

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