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Modeling Airplane Load Sheet using Wireless Communication

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Abstract: This study, represents a model of load sheet for generate and print the load sheet wirelessly in the airport environment. The proposed model, suggests generating wirelessly load sheet, including all processing of filling, checking, signing and printing the load sheet from the loading area, depending on the communication capabilities that already available between all devices. Such as wireless printer, wireless access points and wireless router. The proposed model will be suitable for all types of airport environment, through making the task for the load control agent and the captain achieved more efficiently. The main benefits from the proposed model are: it saves time, effort and reduces the overall operating cost of the aircraft. The proposed model represents an efficient integrated method, which takes the advantages of the wireless communication.

Key words: Airport environment, E-business, load sheet, wireless communication, load control, wireless printer

INTRODUCTION

The wireless communications are rapidly expand and developed to include new systems and applications. They have become the subject of interest for many researchers nowadays in many domains; especially in the airport environment (The aviation world) since they can be used at any time and any place. Because airlines in the aviation world depend largely on the wired systems, many problems may occur as a result of that, but the use of the wireless communication model will solve them when applied. Financial problems embrace flight delay, passengers' compensation, fuel and light expenses during the night, ground services for each hour the plane stays at the airport chocks area and over time for staff. There are also resources problems, including human resources, increase of the number of part time employees, suppliers, civil aviation, ground operation and ground handling (Delta airline, 2008). In addition, there are technical problems, comprising uncertainty or inaccuracy of information exchange and distance between deferent areas of the airport. Logistic problems will deal with flight delay and interference in transmission. To solve all these problems a model is designed to help the airline company, specially the employees working in the company, to print the load sheet wirelessly instead of using the wired systems which are limited in place. The model will use as main tools (Wireless Access Points), (PDA), (wireless printer) (Lap Top) to be connected wirelessly to the office and help print load sheet directly from/ under the air craft. These tools will directly be connected to the head office and data will be saved in the database of the head office and the head office should confirm that the data is received and then send it again to print the load sheet wirelessly, which includes all required information about the air craft, directly by employee (Chen *et al*., 2009). The proposed model is intended to serve many departments in the airport environment; the Ground Handling Agent (GHA), all the airline companies and even the employees. The airline company wills benefits by increasing the efficiency of the work performance as it tends to use the wireless communication system instead of the current wired system. Poorazizi *et al*. (2008) said that field based and GPS assisted GIS are frequently used in various geosciences applications. Such systems deliver more advanced, time and cost effective tools than traditional field forms for information collection.

The aircraft will takeoff as scheduled without any postponement, so the wireless communication system will provide more effective real-time solutions to the problem that might occur. The airline companies and the handling agent company will benefit from such new system which saves time, cost and the number of employees needed to tackle the default. Then, the wired system is restricted to one place and it might only cover limited areas. Therefore, the load control agents have to contact with the ramp agent in order to know the needed information about the load sheet and if a mistake occurred from either the former or the later, the safety of the aircraft and the passengers will be greatly affected.

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However, the wireless system depends mainly on waves and frequencies, so it can extend and cover vast areas (Mitchell, 1999; Dasbootjoe, 2008). Accuracy in sending and receiving information is very essential and it can be achieved through the use of the wireless communication since the possibility of making errors is less because the same load control agent employee can by himself control the whole situation directly. In addition, the current situation in the airport imposes having an employee (The Load Control Agent) who sets in the office, not moving, to control and communicate the process of printing the load sheet till being completed, but the use of the new technology does not require that since a single person can do the work of many employees as he can control the loading and printing the load sheet process from the same place without returning back to the office to modify and print another load sheet when there is a (LMC).

The use of PDA and CRM within the wireless communication system will facilitate both the checking and signing processes which is easier not only for the employee, but also for the captain because the captain will not wait a long time to make sure that every data entered (Wang and Poor, 2004) in the load sheet is exactly the same as the data given to the load control agent by the captain. Therefore, both the captain and the load sheet agent will sign it directly on the (PDA) and/or (CRM) devices or (LAPTOP) instead of papers.

PROPOSED WORK AREA

Figure 1 presents the work area of the proposed model of using wireless communication system. As shown in the work area, the proposed model connects with the office through wireless connection. The office already supported with hardware and software to store and generate load sheet, as well as, the database contains all data and information's about the airline. Therefore, the proposed model will benefits from the database and equipments in the airline office. The wireless equipments preferred in the proposed model have the capabilities to cover wider areas and strength signals, as well as, protected from all types of collisions.

ANALYSIS OF LOADSHEET PROCESS

Approved loading system means a system prepared by an operator in accordance with the requirements of and approved by holder of an appropriate and valid Weight Control Authority for ensuring that an aircraft is loaded within approved limits at all times during flight. Load sheet means a form for recording the weight and disposition of the disposable load together with other pertinent loading information. Approved load controller means a person nominated by an operator and approved by Civil Aviation Safety Authority (CASA) to carry out all or any of the duties involved in the control and

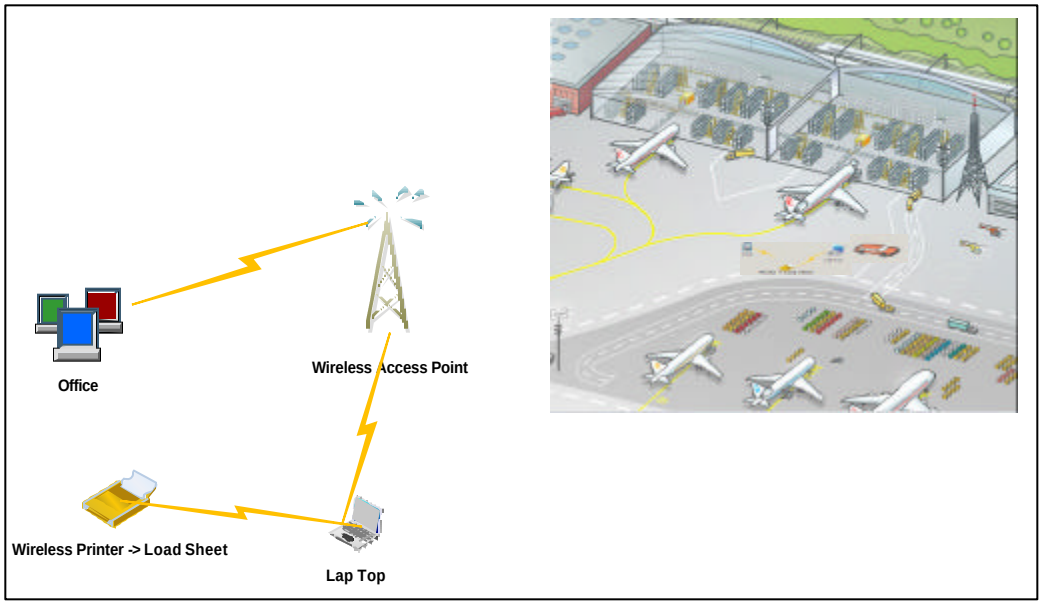

Fig. 1: An overview of the work area

supervision of aircraft loading in a particular aircraft. The load sheet must be singed by an agent holding a valid load control qualification. The commander sings the load sheet for approving it. However, he only checks if flight number, date, registration, number of crew, routing and fuel figures are correct to ensure that the aeroplan is loaded within its limits regarding its center of gravity and maximum permissible gross mass. In addition, each company has a particular procedure and system to deal with the load sheet and balance chart (Gainjet Aviation, 2009).

The traditional way of delivering the load sheet is by hand to the cockpit before departure .The fianl load sheet is typically the very last document that the pilot must have before departure. Saving a minute or two in the delivery of the load sheet is therefore important in order to improve on-time performance and reduce turnaround times. There are many crucial elements in load sheet process which include fuel docket (completed and signed by the captain for every departing flight), load sheet plan, finalize load sheet and ensure that centre of gravity and weights are within the specified limits and trim.

Fuel docket must include specific data inserted to the system; these elements are takeoff fuel, trip fuel, tax fuel, crew count, aircraft registration and MALTOW (Maximum Landing Takeoff Weight) or RTOW (Regulated Regulatory Takeoff Weight). Load plan includes blocked passenger, booked passenger baggage, baggage container tare weight, E.I.C. and final cargo male figures (Jeppesen, 2009). These data are inserted with the system and can be controlled/changed by the load controller. Within finalize load sheet process; to generate the load sheet, the passenger figures, baggage figures and fuel figures must be finalized by system and are also controlled by the load controller. The final element/step within load sheet process which is ensuring that Centre of Gravity and Weights are within the specified limits and Trim will lead necessarily to a successful completion of the whole process (Load sheet Process). However, Last Minute Change (LMC) should be taken into account and there two possibilities for that. It is either that there should be LMC or not. In the first case (yes), changes should be made to make sure that limits are not exceeded or under loaded before moving to the next step. But if it is (No), the successfully completed load sheet should then be offered to the Commander at no later than -10 STD (Schedule Time of Departure). Last minute change means any change concerning traffic load: passengers, baggage, cargo, fuel (useable or not) occurring after the insurance of the load and trim sheet (Saudi Airline, 2007; Etihad Airways, 2009). It is only permitted if load sheet changes are within prescribed tolerances which in turn must ensure that:

- None of the maximum operational limiting weights are exceeded, such as Zero Fuel Weight (ZFW), Takeoff Weight (TOW) and Landing Weight (LDW)
- No loading limitation is exceeded
- The Zero Fuel Weight Centre of Gravity (ZFW CG) and Takeoff Weight Centre of Gravity (TOW CG) remain within allowed limits

The use of LMC box enables changes to be made to the total traffic load after the completion of the loadsheet. LMC can be made without any other changes to the loadsheet within the aircraft and changes in the Traffic Load are done by entering the item in the item in the LMC box. Provided the total change is within the underload figure, no correction is made to the zero fuel weight, takeoff weight, or landing weight.

Figure 2 presents all the required processes within the load sheet These processes are complementery with each other in their effect in the overall of the completion of the load sheet.

Proposed model using wireless communication system: Figure 3 presents the Data Flow Diagram (DFD) using the WLAN in the proposed model which will facilitate the whole work of generating and printing the load sheet outside the office (under the aircraft). The Wireless Local Area Network (WLAN) uses spread-spectrum technology based on radio waves to enable communication between devices in a limited/vast area (Schwartz, 1996). This gives the users, the mobility to move around within a broad coverage area and still be connected to the network. Nowadays, using the WLAN has become widespread due to ease of installation and location freedom, especially with the increasing gaining popularity of laptops. The popularity of using WLANs is due to its convenience, cost efficiency and ease of integration with other networks and network components.

Context diagram of the proposed model: Figure 4 presents the context diagram of the proposed model. It shows the proposed model boundaries in its actual environment, as well shows all objects/devices that communicates with these are captains, load controller, host server, aircraft printer, database, car printer and office printer.

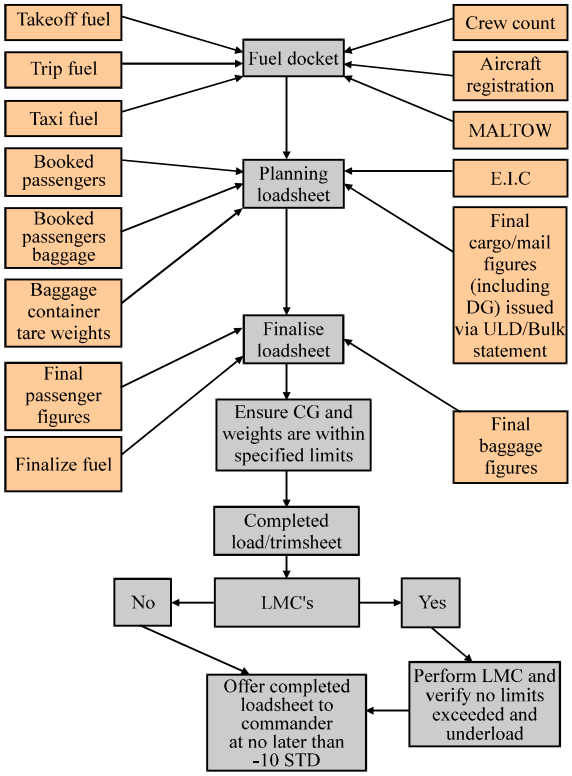

Fig. 2: Load sheet process

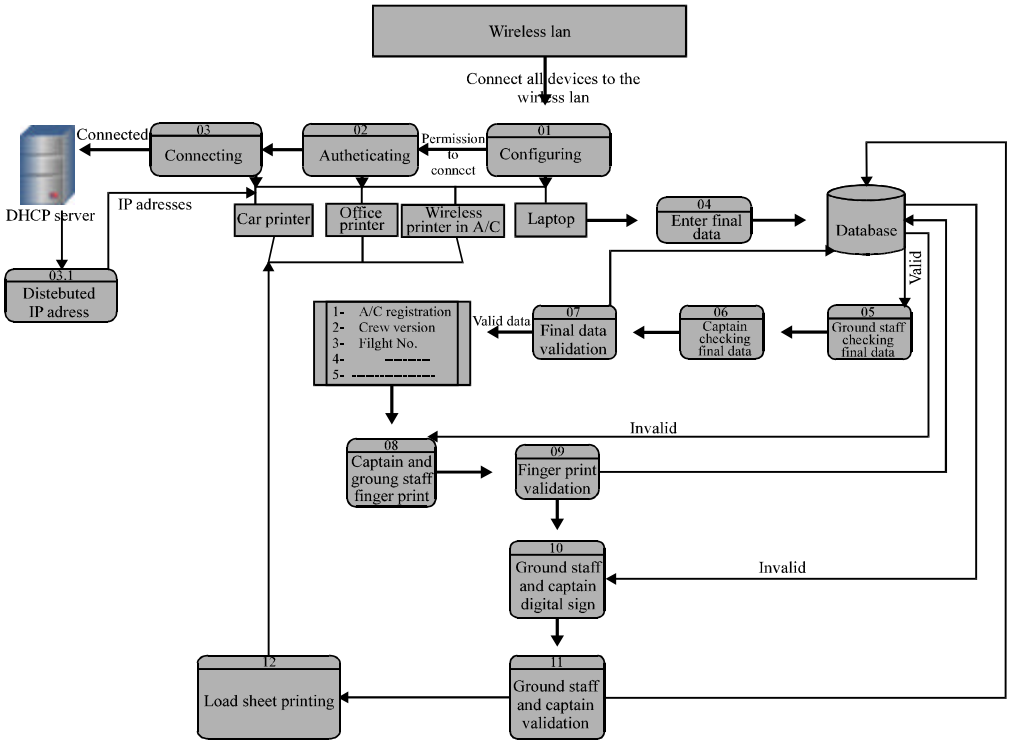

Fig. 3: Data flow diagram of the proposed model

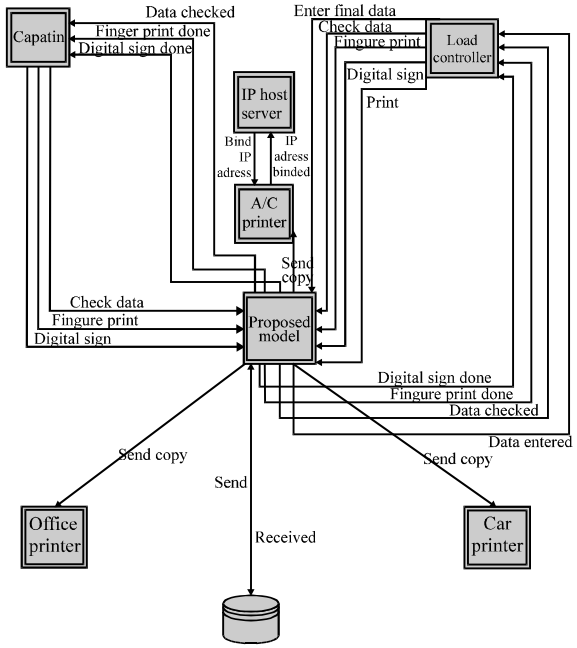

Fig. 4: Context diagram of the proposed model

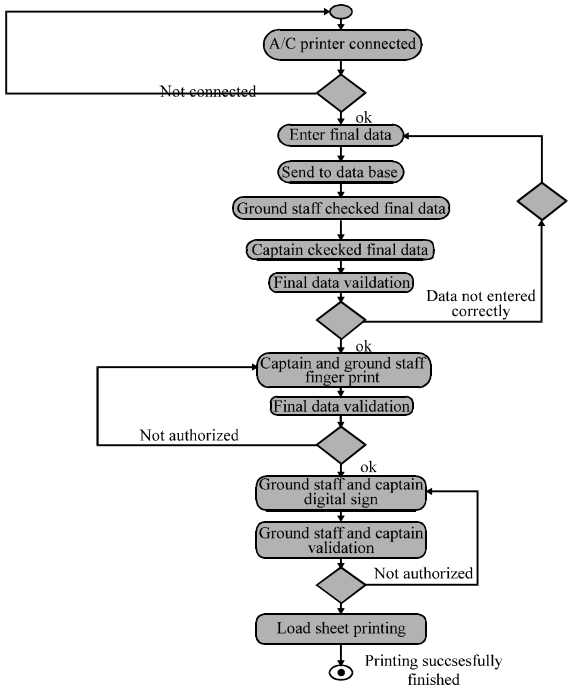

Fig. 5: Activity diagram of the proposed model

Activity diagram of the proposed model: Figure 5 presents the activity diagram of the proposed model shows the rounded rectangles which are present the activities inside the model.

These are aircraft printer connection, the data entry, processing the database, checking data by ground staff, checks data by the captain, captain authentication using fingerprint, authentication by the load controller using fingerprint, ground staff authentication using digital sign and finally the process of printing the load sheet.

CONCLUSIONS

The completion of generating the load sheet process should be highly successful, accurate and systematic because of the great importance of the load sheet as an IATA standard format. It contains critical information about each element on board/on loads to the aircraft, such as zero fuel weight and regulated take-off weight. The proposed model will solve the problems that the airline companies might face such as, financial, technical and logistic problems as a result of the wired system use to print the load sheet. From the practice experience in the load sheet, using the wired system leads to flight delay, time and effort consuming, increasing the costs and reducing the level of accuracy and efficiency achieved in the work. However, time, effort and cost are important business needs in the aviation world. Based on the proposed model the following points can be conclude:

- The load control agent who produce a load sheet for the aircraft in accordance to the actual load of the aircraft, he must move from one place to another (from the office to the ramp area) to accomplish his task, which will take much time and waste more efforts fruitlessly because of the airports vast areas
- From studying the previous works, different types of load sheet are discussed to show how it generates and prints the load sheet using different systems. These systems have certain disadvantages that the proposed model tries to avoid in order to achieve the desired results and serve the purposes in a better way
- The proposed model represents a complete blueprint designed to generate and print the load sheet wirelessly. This is through two main phases, Phase one explains how the wireless connection will be established through authentication and configuration while phase two describes the load sheet processes in details
- All communication will be done through using the WLAN which must established in the ramp area and in the airport building through using wireless router

- All devices in the proposed model use an, authentication which means taking the permission for these wireless devices to be connected on the WLAN
- The proposed model will increase the level of efficiency by reducing the possibility of making errors
- The main benefits from the proposed model are: it saves time, effort and reduces the overall operating cost of the aircraft
- The proposed model will be suitable for all types of airport environment, through making the task for the load control agent and the captain achieved more efficiently

The future work and extend the proposed model we suggest several recommendations for future works, these are:

- The airline companies invited to adopt this new proposition in order to carry it to the practical sphere. To assess its efficiency and take an advantage of all the distinguishing features of this new technology (proposed model) offers
- Adding some other features to improve and expands its application and uses it for other domains to generating and printing the load sheet wirelessly, such as: shipping ports
- The aircrafts manufacturer companies should provide the aircrafts with wireless technology such as wireless printer to enable the aircraft connection process between the captain and the station be completed successfully, especially when the aircraft airborne or lands by sending specific telegrams from the system which is already installed on the laptop

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