Civil Aviation Etiquette Robot System Based on Decision Tree Model

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Abstract. With the improvement of people's living standards, the requirements for intelligent services are getting higher and higher. As a kind of service robot, the ceremonial robot is often used in various occasions to receive customers' greeters. It not only reduces the workload of employees, but also provides a good customer service experience. This paper studies the etiquette robots in the civil aviation field, develops a etiquette robot system based on the decision number model, and evaluates the service quality of the etiquette robots. The evaluation results show that the robot's various service indicators are recognized by passengers. The civil aviation robot system can Invest in the civil aviation industry to better serve flight passengers.

Keywords: Decision tree model · Civil aviation etiquette · Etiquette robot · System development

1 Introduction

With the advancement of technology, economic growth and the continuous improvement of people's quality of life, robots will gradually affect various living conditions of human beings. At the same time, robots can also provide people with convenient services. In civil aviation etiquette services, the use of robots is to allow people to experience high-quality services that meet the needs of passengers.

Many scholars at home and abroad have conducted research on the development of civil aviation etiquette robot system based on decision tree model, and have achieved good research results. For example, a scholar has developed a ceremonial robot. The biggest feature of the robot is that it has an advanced navigation system that can help its GPS to indicate the route for users. In addition, infrared detectors and ultrasonic sensors are installed to detect obstacles. Accurate measurement and positioning can be used in airports to guide passengers to take flight routes, and it can also assist cleaning workers in cleaning airport hygiene [1]. A scientific research team used data algorithms to design a robot suitable for reception at the door, and placed the robot at the door of a clothing store. Whether the customer enters the store or leaves, the robot will bow and show good. Through the control of the instruction program, the robot can also let the robot interact with the customer simple dialogue [2]. Although the research results of the development

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of the civil aviation etiquette robot system based on the decision tree model are good, there are few practical applications in the civil aviation field. The application of this system should be vigorously promoted to improve the quality of civil aviation services.

This article introduces the functions of civil aviation etiquette robots and the hardware requirements of the robot system design. According to the decision tree model, the structure of the civil aviation etiquette robot control system is designed. An appropriate power supply is placed in the robot body to realize the normal operation of the etiquette robot. Afterwards, evaluate the service quality during the application of the etiquette robot to understand the passenger's satisfaction with the robot service.

2 Civil Aviation Etiquette Robot Functions and System Design Requirements

2.1 Civil Aviation Etiquette Services

Civil aviation etiquette service is the process of providing passenger services to meet the needs of passengers in accordance with relevant matters and regulatory requirements in the airport or cabin as the service place. From a broad perspective, it is further understood that civil aviation etiquette services are the integration of systematic activities, and the perfect combination of technical and normative processes and the service objectives of civil aviation enterprises. The key components of civil aviation services are safety and service. The two factors support and promote each other, improve service quality, create a favorable environment for safety, build development on the basis of quality assurance, and avoid blind pursuit of speed and scale.

2.2 Introduction to the Functions of Civil Aviation Etiquette Robots

(1) Basic functions

The civil aviation etiquette robot is a kind of acousto-optic, electromechanical, and it looks like a human. It has certain visual, tactile and voice functions. It can walk and beckon to hug. It is suitable for greeters who treat passengers at the airport. Combining popular science and increasing entertainment, large robotic animals that simulate human or animal actions are designed to enrich passengers' waiting time. The functions that the civil aviation etiquette robot studied in this article should have are: it can automatically distinguish the arrival or departure of guests, give welcome or farewell speeches, and make corresponding welcome or farewell actions; it can have simple conversations with passengers; it has a distance measurement function, no It can collide with obstacles; it can store the program list, and can sing and dance; through the touch screen on the robot's chest, you can learn about the relevant information of the corresponding unit [3, 4].

(2) Function of multi-sensor system

Before determining the functional requirements of the ceremonial robot multi-sensor system, it is necessary to clarify the various functions of the ceremonial robot. Ceremonial robots can be used in many occasions to serve people. For example,

when the flight crew enters the airport, the ceremonial robot can be placed at the door to greet the passenger. When the passenger arrives, it greets the passenger and makes a handshake welcoming gesture. When the passenger leaves, it bids farewell to the passenger and wave goodbye action; In addition, the ceremonial robot can also be moved freely in a certain field, and can actively avoid obstacles during the free movement process, and at the same time can express information with voice. When the robot is moving, it is necessary to avoid collisions with surrounding objects, and emergency stop measures should be taken when necessary. In addition, the ceremonial robot can also guide passengers to the waiting room. During this process, the ceremonial robot can walk along the wall and always keep a certain distance from the wall. In addition, the ceremonial robot can also perform programs for passengers while they are waiting for the flight. Such as singing and dancing. Of course, when to enable the above functions, people need to issue control commands to choose, which requires the human-computer interaction function of the ceremonial robot [5, 6].

2.3 The Hardware Design of the Etiquette Robot System

(1) The design of the host computer

Welcome and free movement are two different states. The robot needs to accept commands and choose to run in an adaptive state according to different occasions, so as to achieve the purpose of real-time control. The host computer should be installed in the body of the robot and move with the robot. Due to the limited space in the robot body, the size requirements need to be met, except for the display and the rest of the touch screen, the size should be as small as possible to save internal space [7].

(2) The design of the main controller module

The main controller is the core of the lower computer, which is mainly responsible for real-time acquisition, processing, and output control signals of multi-sensor information, and communicates with the upper computer and accepts commands from the upper computer. Since the controller is used in the mobile robot, the mobile robot uses an internal power source, and it is necessary to reduce the power consumption of the system under the condition of a certain endurance. In addition, the stability of the system must be guaranteed. System stability is the prerequisite for the normal operation of the system. The more complex the system, the more difficult it is to control it stably. On the premise of ensuring the normal operation of the system, a cost-effective controller should be used as much as possible [8].

(3) Design of sensor module

During the welcoming process, the sensor robot used to detect the entrance and exit of guests is usually placed at the entrance of the hall in the welcoming state, and defaults to a static standing posture. At this time, the robot is required to be able to perceive human movement within at least 3m in front of itself, and determine whether the guest is coming or going out. The infrared pyroelectric sensor can perceive the moving life body in the surrounding environment, which

is very suitable for detecting human movement. If there is infrared radiation in the surrounding environment, the surface temperature of the pyroelectric material will change, and the temperature change will cause the surface electric dipole moment to change, thereby generating electric charges. The charge released by pyroelectric materials changes with the change of infrared radiation [9, 10].

(4) Sensors used to detect obstacles in free movement

In the process of free movement, the ceremonial robot should effectively avoid the surrounding obstacles. Since the ceremonial robot can be used for entertainment performances and services, there are usually crowds of onlookers, and the space of the venue will be very limited. In order to save space, the robot should be moved in the process as close to obstacles as possible, it is necessary to select a sensor that can detect obstacles within a short distance. Secondly, because it is mainly used for short-distance detection, the accuracy of the sensor is required to be high. Furthermore, for the obstacle distance within the detection range, an accurate distance value must be obtained so as to adopt different avoidance strategies for obstacles at different distances [11].

2.4 ID3 of Decision Tree Algorithm

The ID3 algorithm uses information entropy as a template to measure the balance of the number of samples in each category in the sample set, and then uses information gain (the reduction of information entropy) as the template selection feature to segment it, so as to achieve tree building and classification [12].

The information entropy calculation formula is as follows:

$$I(X) = -p\log_2^p - (1-p)\log_2^{1-p} \tag{1}$$

Among them, X is the set of examples, and p is the proportion of the number of positive examples in the total number of examples.

The calculation formula of subtree information entropy is:

$$New\_I(X, G_i) = \sum_{j \in V(G_i)} \frac{|X_j|}{|X|} I(X_j) \tag{2}$$

Among them, G_i is the discrete attribute, and X_j is the sample set with $G_i = \mathrm{j}$ in the sample set X.

3 Civil Aviation Etiquette Robot System Design

3.1 The Structure Design of the Civil Aviation Etiquette Robot Control System

Figure 1 shows the structure of the control system of the civil aviation etiquette robot. The civil aviation etiquette robot control system is operated by the upper and lower computers together to control the behavior mode of the robot. Since the ceremonial robot must have robust performance to the environment and the ability to transmit information smoothly,

it can not only collect environmental information steadily and quickly, but also transmit the external environmental information to the robot control system in a timely and accurate manner. Therefore, a sensor unit is needed. Check environmental conditions. At the same time, the ceremonial robot has a fixed gait mechanism, which can perform multiple sets of different welcoming actions according to different situations, reflecting that the control system needs a fixed drive unit to control the robot's movement. The ceremonial robot has a remote control function, and the user can give instructions to the robot through the remote control, so the control system needs a fixed remote control unit.

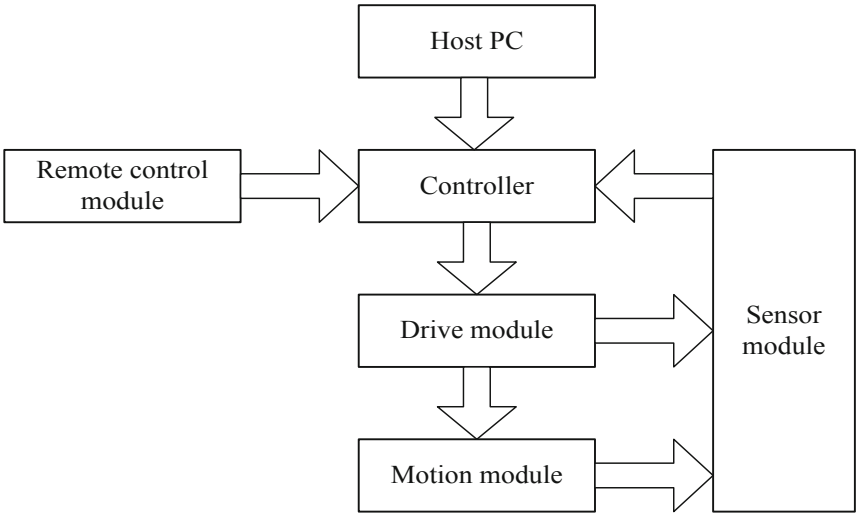

Fig. 1. Architecture block diagram of civil aviation etiquette robot

3.2 Robot Power Supply Selection

Table 1. Battery characteristics

	Nickel-cadmium batteries	NiMH batteries	Lithium ion battery	Lithium polymer battery	Lead-acid batteries
Energy density (wh/kg)	35–40	60–75	85–110	125–135	30–50
Cycle life (times)	350–500	800–1000	500–650	500–600	400–550

Table 1 shows the basic characteristics of different types of batteries. For example, the energy density of nickel-cadmium batteries is 35–40 wh/kg, and the cycle life can reach 350–500 times. The energy density of nickel-hydrogen batteries is 60–75 wh/kg, cycle. The life span can reach 800–1000 times. The civil aviation etiquette robot needs to realize movement, handshake and other actions, energy is the foundation, and the power module is the power source of the robot. The power supply module can be divided into external power supply and internal power supply. The external power supply is the power adapter. The external power supply powered by the cable can provide the necessary energy for the robot and the power needed for PC debugging. However, the length of the power adapter cable is limited, which makes the ceremonial robot flexible and mobile. The range is greatly reduced, which deviates from the original intention of developing ceremonial robots, and may cause the plug of the adapter to shake during the robot's working process, which poses a certain safety hazard. The stability of the power supply determines the stability of the control system to a large extent, so it is very necessary to provide a stable power supply module inside the robot body.

4 Implementation of Civil Aviation Etiquette Robot System Based on Decision Tree Model

4.1 Welcome Program of the Control System

After starting the welcome function through the welcome button on the human-machine interface of the host computer or pressing the remote control key, the robot will enter the welcome mode. After entering the welcoming state, it will first determine whether there is anyone coming in. If so, the ceremonial robot will make corresponding welcome actions and voices, such as saying "hello" to the guest while nodding slightly and raising the right hand to express welcome. If someone goes out, make a goodbye action and voice, such as saying "goodbye, welcome to come again next time" to the guest and beckoning goodbye. If the guest sends an information query instruction through the welcome interface of the host computer, the guest will find the information that he is interested in. If the guest uses the remote control to send instructions to the robot, the robot will complete the corresponding actions in accordance with the received instructions. If the guest issued an instruction for the operation interface, the display screen will show the operation interface. If there is no command signal, it will return to the main program. The flow chart of the welcoming module is shown in Fig. 2.

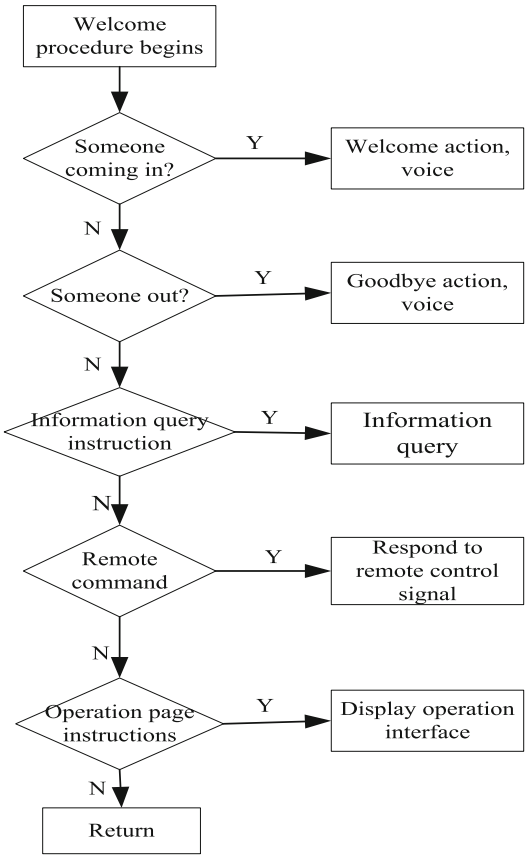

Fig. 2. Welcome process of the etiquette robot control system

4.2 Service Quality Analysis of Civil Aviation Etiquette Robots

The service indicators of civil aviation etiquette robots are scored, and the full score for each indicator is 10 points. The results are shown in Fig. 3. For the robot to quickly respond to customer inquiries, the score is 8.87 points, the service index for keeping the cabin environment clean and tidy is 8.64 points, and the service index for robots welcoming people through infrared heat sensing is 9.17 points, waving and shaking hands with customers to show okay, the service index score for waving goodbye was 9.93 points, the performance score for guiding customers was 9.65 points, and the performance score for customers' checked baggage was 9.8 points. It can be seen that people are more satisfied with the service quality of the civil aviation etiquette robot. The use of the robot can not only reduce the workload of flight attendants, but also meet people's riding needs.

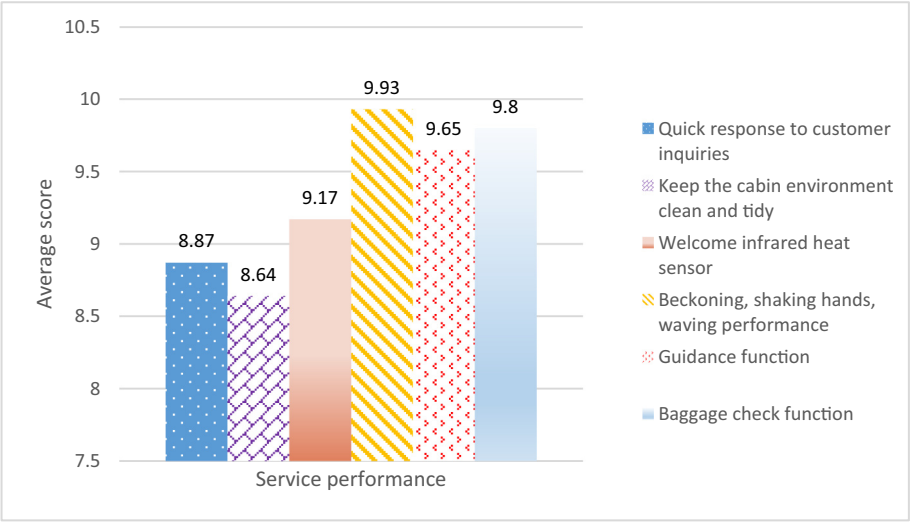

Fig. 3. Service index scoring results of civil aviation etiquette robots

5 Conclusion

Etiquette robots are mostly used in hotels, clubs and other occasions that need to receive guests, but they are rarely used in civil aviation. This article is to study the etiquette robot system in the direction of civil aviation. Based on the decision tree model, the etiquette robot control system is developed and designed to serve airport passengers and improve the quality of etiquette services. The development of this robot also reflects the intersection of modern science and technology, and demonstrates the country's comprehensive scientific and technological strength and level.

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