FlightBot: Towards Improving in-Flight Customer Experience Through The Use Of Robotics

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***Abstract*—Recent advances in robotics have affected various industries across the world, especially service areas. One of the most challenging areas is in-flight service, which has huge potential in terms of business as well as customer satisfaction. In this paper, we propose a novel robotic system, called the in-Flight Autonomous Customer Care System (iFACCS) that enhances a flight attendant's duties and affords passengers with a more pleasant travel experience. The iFACCS allows passengers to request catering services as well as travel items through a customer application at their seat and flight attendants to deliver the requested services and items to the customers via a semi-autonomous robot, called FlightBot on-board the aircraft. We discuss the state of art of such service systems and their limitations, propose the architecture of the iFACCS, describe our preliminary work, and elaborate on the challenges faced during the development of our the robotic system.**

***Index Terms*—In-flight robot; flight attendant robot; autonomous systems; human robot interaction**

I. Introduction

Job automation has affected various industries across the world. For example, the use of software automation in finance has enabled for more efficient and reliable processes to take place without the need for manual input. Other examples include, the use of machine learning for anomaly detection, which has improved the speed of error detection and allowed for more effective countermeasures to be deployed. Most notably, industries which relied heavily on manufacturing were among the first adopters of robotic systems. Such systems, in essence, automated the jobs of manual laborers and reduced the number of laborers required in the assembly line. Currently, it is even unusual to think of a car manufacturing company which does not rely on the use robotic assembly lines.

Closer to home, automation has brought efficiency and transformed jobs that were thought to be susceptible to job automation such as cashier or bank tellers. In the case of bank tellers, the introduction of smarter Automated Teller Machines (ATMs) brought changes to the job itself. Contrary to prediction, the introduction of such systems allowed for banks to cut operational costs in opening new branches, and hence bank teller employment increased [7], [8]. However, with the introduction of such technology, the tasks of bank tellers evolved to include focus on the aspects of customer relationship management, and investment advice in some cases. Overall, different levels of automation have brought efficiency across industries and allowed laborers to focus and train for tasks that require a higher degree of human attention.

While this is a reality across many industries, the flight industry has seen the use of automation on ground systems and in pilot system that assist pilots during takeoff, landing and flight. But, there hasnt been a focus on the customer service aspect of the flight industry. Most notably, there has not been any focus on the use of automation to enhance the onboard customer flight experience. As surveys show, customers often complain about the professionalism of flight attendants onboard and about the service they receive [5].

The current established process for attending to passenger on board an aircraft has many challenges and issues that need to be addressed. For example, airline companies often feel that there is a dire need for multiple flight attendants on a plane to achieve higher levels of customer service. This in turn leads to higher operational costs for airline companies that have to hire multiple flight attendants. Furthermore, dimensional constraints within an aircrafts aisle leads to congestions when catering food, thus leading to an inefficient form of food delivery system.

According to the willrobotstakemyjob website, it is believed that there is only a 35% chance of automation of a flight attendants job [6]. This is inherently due to the perceived high-level of human interaction involved with a flight attendants job tasks. Rather than doing away with a flight attendants job our systems hopes to enhances a flight attendants capabilities and drive efficiency across the currently establish inflight customer service process.

Thus, our system aims to optimized commonly established metrics used to assess customer satisfaction, such as that of time of service, quality of service and accuracy of service [9], [10], [11]. In turn, improving the overall travel experience through efficiency and customized service which can positively impact an airlines satisfaction rating.

II. State of the Art

In 1965 Martin Limanoff developed a robotic system that was designed to travel down an aisle along a monorail track delivering food to passengers [12]. Later in 2015, Sell GMBH, a German division of Zodiac Aerospace, filed a patent for a food distribution mechanism whose design was a hybrid between a conveyor and automat machine. The latter system, requires the customization of existing aircraft since it requires that the system be embedded under the floor and that contraption under the seat be made [14]. As it currently stands, there has not been much research and development to automate or enhance the services provided during flight. One of the key factors behind a pleasant flight experience is customer service, which is provided by flight attendants. This factor is overshadowed by existing approaches, such as that of GMBH, that bring regulatory concerns over redesigning and reengineering existing aircrafts.

The cost of performing such tasks is also concerning. But, interestingly, during the Disrupt San Francisco Hackathon, engineers Peter Ma, Eddie Aguilar, Diego Gonzalez, Brian Cottrell and Savalas Colbert, integrated the Pepper companion, IBM watsons artificial intelligence system for natural language, the Panasonics inflight data and displays and Here maps indoor navigational data to create an human like robot flight attendant [1]. Their project showed that in the near future it will be possible to automate certain tasks of flight attendants duty, but failed to tackle existing concerns over functionality, efficiency, integration and cost. The cost of the robot and other components are relatively high, driving up operational costs of airlines. Furthermore, given the robots payload and actuation constraints, it cannot carry multiple items at the same time, making it a daunting task to assist multiple passengers.

A flight attendants salary is an average of $50,000 and their main function is to provide all passenger services and do security checks in flight. The american law, requires 1 flight attendant per 50 passengers but some companies use more flight attendants to have better service and be able to provide better care for the passengers [2]. This increases the cost the airlines companies pay. Delta airlines, one of the biggest airlines companies in the world, offers 15,000 flights daily [3] , if we set and average of 3 flight attendants per flight, it amounts to 821.25 million dollars a year, every year. Another situation that arises is that every time a passenger needs a service, the passenger needs to call the flight attendant, make a request, wait for the flight attendant to go prepare the request and then bring the passenger request, it becomes and exhausting and time taking process that affect other passengers and the flight attendant itself.

III. Proposed Solution

Our system, known as in-Flight Autonomous Customer Care System (iFACCS), is depicted in Figure 1. The system has four software and hardware components: a customer care service layer, a client software application, a flight attendant software application and the flight attendant robot, called FlightBot.

The customer care service layer establishes the communication between the client application and the flight attendant application, and encompasses a data layer which is leveraged for long-term analysis of requests and service time. On the customer application, passengers are able to choose from a list of available services and make payments for items. Such services include the catering of food or the sale travel items such as pillows or blankets. The application is available as a mobile or web application, and can be displayed in an

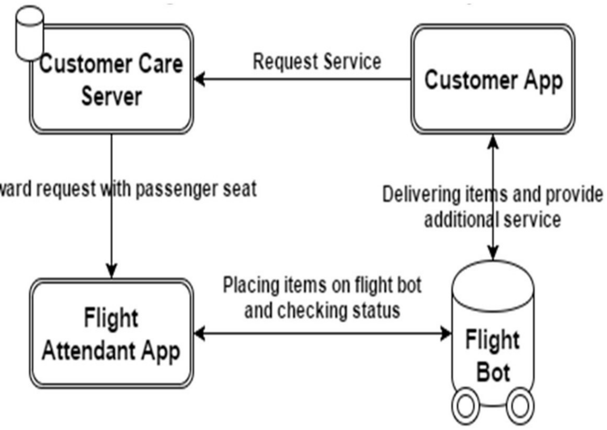


Fig. 1: iFACCS System Architecture

aircraft seat screens. On the other end, the flight attendants receive notifications of a passengers request through the flight attendant application (master application). The last component is FlightBot. Once the flight attendant receives a passengers request, the attendant is able to place the items on an available FlightBot and direct the robot to deliver the item to a specific passenger seat(s).

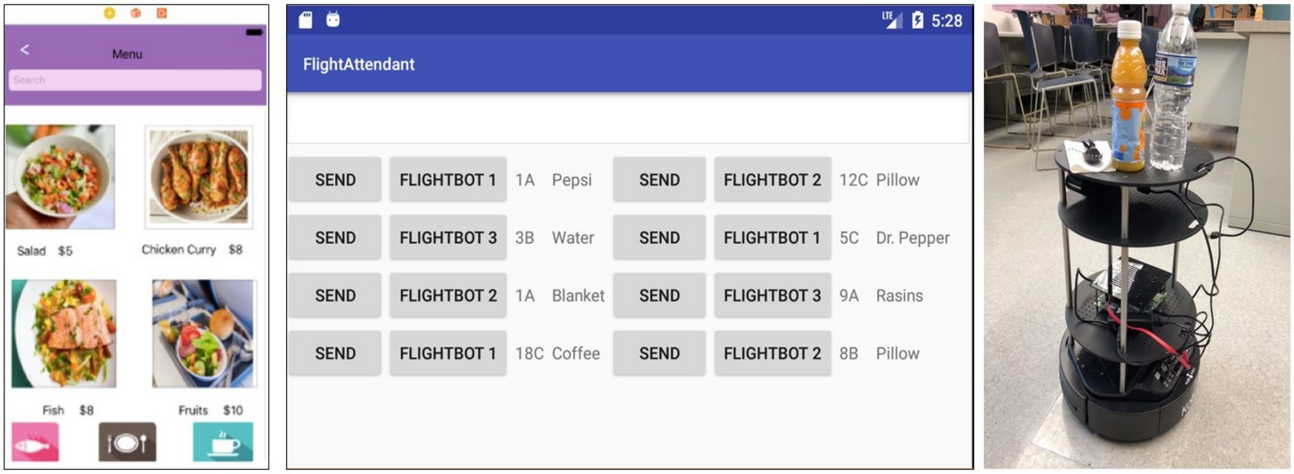
The FlightBot is able to perform a flight attendants task of delivery goods, while taking less space and being more efficient. The use of such system can be further leveraged to personalize the customer experience. The goal of the system is not to completely remove all flight attendants or take all of their functions but to reduce their job duties to highest level tasks while the robot performs the lowest or most redundant tasks.

Our system's main focus is to optimize passenger service servicing task that flight attendants perform. To improve passenger experience, we plan to reduce the iterations passengers need to have with a flight attendant to request a service and consequently reducing the wait time by allowing the passenger to directly request what they want through the application.

Our system further tackles another pain point that passengers experience while on the plane, aisle congestion. Because our automated robot has low profile morphology, it can take half the size of an aisle. Therefore reducing the congestion since people will be able to move along the robot.

Our robot shows the security directions through its equipped LCD screens allowing the passengers to be aware of the robots intentions. The robot is also equipped with speakers and a microphone giving the possibility for the passenger to communicate directly with the essential flight attendant. For the movement along the isles, the FlightBot will have infrared sensors in the top and middle area so that it can detect and avoid people. The robot will have inner racks where food and drinks will be contained, being able to carry 5-15 items, depending on the height of the robot specified.

We also plan on adding safety features where the robot will be able to check using sensors for non-allowed items and



(a) Customer Application (b) Flight Attendant Application (c) FlightBot Prototype

Fig. 2: Screenshots of a customer application and a flight attendant application, and a kobuki-based FlightBot prototype

check that all passengers seat belts are on and tables closed. We will add various emergency aid capabilities to the robot, being able to deploy inflatables to soften passengers impact in case of a crash and to work as buoyancy objects if a crash is in the ocean.

IV. Preliminary Work

The early stages of our work focuses on developing a robot that is affordable, autonomous, light and small, which will carry out the tasks of delivering items. The first prototype of the iFACCS system is composed of four components, a physical robot, a customer application, an attendant application, and a customer care server.

Passengers can request a certain service or request any item (i.e. food, drinks, pillows, etc.) using the customer application as depicted at Figure 2(a). The flight attendant is then notified through the flight-attendant application as depicted at Figure 2(b), places the request item in the kobuki-based FlightBot as depicted at Figure 2(c) and the FlightBot autonomously delivers it to the passenger.

The FlightBot and software is based on the turtlebot robotic kit and is controlled by ROS. The robot can be teleoperated by a person or can run autonomously by providing the robot with a map of the environment. Since the airplane space is small, the FlightBot should not occupy a broad space.

The FlightBot detects when there is people in the way using infrared sensors and stops or chooses a different path. The FlightBot is 2.35kg and can have a 4-5 kg payload [4], is considerably lighter than humans, and is also one time cost with our estimates being less than $1000 for a full service, this way reducing the money companies spend with fuel and staff salary. Because of the small size of the FlightBot there will be less congestions in the isles too ensuring that passengers move through the plane without having to wait for the flight attendants to finish the service.

The application will be available for all mobile platforms, web and on the in-flight screens where users can make their request without having to go through multiple interactions with the flight attendant. Passengers will also have the option to request for the flight attendant through the application if they need a more specific service. This will shorten the waiting time for services and improve passenger experience.

V. Discussion

Many technical challenges need to be tackled prior to a full release of iFACCS into a real-world environment. One of the challenges relates to safety. In a case of an emergency, such as unexpected turbulence, the robot may be a threat to the passengers safety. Therefore, a proper secure binding mechanism between the robot and the plane needs to be designed. To address that issue we plan on creating a stable base for the robot that allows the robot to maintain itself on the floor at all times. However, it is still quite difficult to develop the robots behavior towards passengers and flight attendants during various emergency situations.

In addition, the security and integrity of the system should be considered to prevent events such as hacking. We plan to create a dedicated and secure network for the robot and the essential flight attendant tablet. The user app does not communicate directly to the robot in order to prevent hacking possibility, but rather communicates with the flight attendant application.

Beside many technical challenges, the project faces other difficulties such as current FAA regulations, as well as human factors consideration in various situations.

Nevertheless our iFACCS still has huge potential and those challenges will be addressed in the near future.

VI. Conclusions

In this paper, we have proposed our in-Flight Autonomous Customer Care System, called iFACCS which enhances both the passenger in-flight experience and the cabin crews capabilities. Our system allows passengers to seamlessly request for catering services and travel items such as pillows and blankets. On the other end, our system drives efficiency by enabling quick response and monitoring from flight attendants that can leverage our robotic agent for the delivery of items. Such interaction, not only aims to drive efficiency between the passengers and the cabin crew but also allows the crew to focus on tasks that require more personal care or tasks that drive the sense of hospitality. And It even reduces workload of flight attendants through human robot collaboration as attendants can mainly focus on other important work leaving behind passenger service.

In the preliminary work, we demonstrated feasibility of our proposed system using the customer care server, the customer application, the flight attendant application, and the kobuki-based FlightBot prototype.

In future work, we have a plan to deal with security issues, safety measurements, and human robot interaction.

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