Smart Crew: A Smart Watch Design for Collaboration Amongst Flight Attendants

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Abstract
Collaboration is a core component of work activities amongst flight attendants as they work to promote onboard safety and a high level of customer service. Yet it can be difficult to maintain efficient communication, situation awareness, and information exchange given the technologies currently available on airplanes. We present a prototype called "Smart Crew"; a smart watch application that allows flight attendants to maintain an awareness of each other and communicate through messaging with haptic feedback. It is designed with an emphasis on real time information access and direct communication between flight attendants regardless of their location.

Author Keywords
Flight attendants; situation awareness; collaboration; Crew Resource Management (CRM).

ACM Classification Keywords
H.5.3 [*Computer-supported cooperative work*]: Group and Organization Interfaces

Introduction
Collaboration amongst flight attendants is important as they are responsible for the delivery of both customer

service and on-board safety. Miscommunication or error has the potential to be embarrassing and highly publicized [5]. It can also lead to critical accidents and incidents [5]. Understanding that communication needs to be optimized, past research [5] has emphasized the improvement of communication processes between pilots in the cockpit and cabin crew, but there has been little research that focuses solely on how flight attendants collaborate during flight operation [2]. Thus, there is a gap in understanding how new technologies can support the collaboration needs and practices of flight attendants.

We conducted in-depth interviews with flight attendants from domestic and international airlines with the goal of bridging this gap [7]. Our study focused around their collaborative practices involving flight attendant interaction, awareness, and the exchange of information. Results showed that the tools currently available to flight attendants to aid collaboration (e.g., interphones, call buttons, visual displays) do not easily fit within their needs and routines [7]. Instead, in order to match their on-the-job needs, workarounds were required to communicate with one another and maintain a high level of awareness of the environment. In times of emergency, these tools provide an added cognitive load and were difficult to access [7].

To address these needs, we created a smart watch application called Smart Crew. Smart Crew provides flight attendants with situation awareness to enable seamless collaboration and communication. This is done through real time location tracking of flight attendants, a glanceable information display, and haptic feedback of incoming messages and alerts.

Related Work

The execution of coordinated behaviors amongst team members is called team cognition [3]. Past research shows that teams with a shared mental model are likely to work better together as they interpret cues, prioritize information and make decisions in a similar manner [2,3]. Sharing the same mental model improves the team's synchronization and team cognition and reduces the need to explicitly communicate [6]. To communicate effectively, team members rely on situation awareness, an understanding of what is happening around oneself and with one's team members. Situation awareness helps team members accomplish group tasks [2].

To ensure smooth collaboration and avoidance of errors inflight, all air carriers require their flight crew to mandatory undergo Crew Resource Management training (CRM). The CRM focuses on developing crewmembers' skills in situational awareness, team building, information sharing, problem solving, decision-making, and dealing with automated systems for the safety and efficiency of a flight [4]. Thus, the CRM helps to develop faster team cognition and a shared mental model as all crewmembers are provided the same training and tasks orientation. Yet, despite this training, flight attendants still face challenges in working with their crewmembers because the current collaboration tools available to them are limited [7]. These include interphones (located in several locations throughout most planes), flight attendant call buttons (at each passenger's seat), visual indicators (no-smoking sign, seat belt sign), and audio alerts [1].

Figure 1: Smart Crew Application Watch Face

The watch face displays the aircraft seat-map and crewmembers' locations (detected using a Bluetooth beacon). The lead flight attendant is indicated in lime green and the cabin crewmembers are in orange. Users can see the most recent notifications on the top of the interface, including the current time for the flight. A menu with features is accessed by touching the three dots on the right side of the watch face.

To address the collaboration needs of flight attendants, we designed and developed a collaborative system called Smart Crew, described next.

Prototype Design

Smart Crew is a communication and awareness application for flight attendants that runs on a smart watch. Once the application is turned on, the current aircraft seat-map becomes the default watch face of the smartwatch. All crewmembers (Figure 1) can be seen with their current location. This allows crewmembers to gain real time awareness of each other's position and communicate efficiently with those close to them. Because the application runs on a watch, flight attendants do not need to go to a situated display to gain information about the cabin's current situation (this is the current situation on airplanes). They also do not need to carry or pull out a smartphone.

Interactions

Users interact with the application by swiping up and down on the watch face to move within the spatial map of the plane (Figure 1). Notifications appear on top of the spatial map and more details are available by tapping on the three dots on the right side of the watch face. This provides users with access to the main menu that shows the application's functionality (Figure 2). This includes:

Turbulence: Flight attendants see additional details about notifications that turbulence is coming and for how long. These come from the pilots, or can be set by lead flight attendants using the watch interface.

Passenger Aid: Flight attendants see alerts about any medical emergencies with passengers They can also post any new situations which are then transmitted to all flight attendants..

Fasten Seatbelt: Flight attendants see details about notifications for fastening their seatbelt for safety. These come from the pilots, or can be set by lead flight attendants using the watch interface.

Crewmember Assistance: Flight attendants see notifications about a particular crewmember requiring immediate assistance, the type of help required, and the person's location. They can also report the need for someone to assist them. This causes their icon on the map to change colors so that other flight attendants know they require assistance.

Cabin Check: Flight attendants report when they are done their cabin check at the start of the flight. Flight attendants also see notifications about which crewmembers completed their safety and security checks and how many flight attendants have yet to finish.

Messaging: Flight attendants can select from predefined text messages and send them to one or more flight attendants. We created ten predefined messages associated with a unique vibration for each. When a message arrives, flight attendants can either look at the watch to read it, or feel the vibration pattern. Over time, we hope that users can recognize the vibrations so they no longer need to glance at the watch to see the message. This would allow them to continue on with their current task without additional interactions.

Figure 2: SmartCrew Application Menu

The figure shows the main features that assist flight attendants in their normal routines and emergency situations. Clockwise from the orange icon, buttons include:

1. return home (aircraft seat-map)
2. turbulence
3. passenger aid
4. fasten seatbelt
5. crew member assistance
6. cabin check
7. messaging

Implementation

We designed Smart Crew as a web-based application using the Tizen framework. It runs on Samsung Gear S2. We created a chat server using NodeJS and web sockets to support real-time communication and notifications to all or selected crew members. We used low-range Bluetooth low energy (BLE) beacons to track the location of crew members inside the plane to provide location awareness.

Conclusions

The use of smart watches allows flight attendants to exchange messages instantly or view updates on flight status without the need to hold a device such as a tablet or smartphone. Smart watches allow crewmembers to remotely receive calls from any part of the aircraft and efficiently respond. They do not have to be limited to a centralized location in order to communicate with others (e.g. using an interphone in a small number of locations). By having all crewmembers wear the smartwatch, person-to-person messaging is simplified and does not require the use of a situated display in a small number of airplane locations.

Our prototype contributes to the growing research and demand for incorporating new technologies in the aviation industry. Future work includes testing the usability of Smart Crew with flight attendants in a simulated work environment to improve the features of the design.

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