International Civil Aviation Organization

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Agenda Item 7: **Airport Innovation and Technology**

DIGITAL APRON TOWER: TRANSFORMING AIRPORT OPERATIONS

(Presented by Republic of Korea)

SUMMARY

This paper introduces digital apron tower system currently being deployed at Incheon airport apron tower. This system applies digital tower technologies such as AI, AR, Voice Recognition, and Video Recognition into the existing control tower, integrating control data. It enhances the situational awareness capabilities of air traffic controllers and aids in decision-making.

1. INTRODUCTION

1.1 Incheon Airport utilizes a main ATC tower for the maneuvering area and two Apron control towers for apron areas, ensuring comprehensive oversight of aircraft movements throughout the airport. Each tower is strategically placed to visually monitor all aircraft activities. However, visibility can be hindered in specific locations by terminal buildings and other structures, particularly in low visibility conditions like fog, which may result in aircraft being obscured from controllers' view.

1.2 The Digital Apron Tower supersedes the traditional physical control tower and integrates enhanced capabilities that were previously unavailable. Utilizing infrastructure such as cameras, displays, artificial intelligence (AI), augmented reality (AR), voice recognition, and video recognition, it introduces new functionalities to air traffic control. These advancements empower air traffic controllers to enhance aircraft surveillance, minimize human errors, and thereby significantly improve air traffic control services and apron management services.

1.3 Incheon Airport is currently integrating digital tower technology into its existing physical apron control tower. This initiative aims to maintain the stability of the current control tower infrastructure while taking advantage of the additional benefits provided by the digital tower system.

2. DISCUSSION

2.1 Incheon Airport's digital apron tower system is a distinctive project that diverges from the common digital tower, where physical towers are converted into remote digital ones. Instead, this system integrates digital tower technology to the airport's existing operational physical control tower.

2.2   Incheon Airport's digital apron tower system installs displays atop the current control room consoles. This setup enables air traffic controllers to visually monitor aircraft through the physical tower windows while also using the digital tower displays as needed. The configuration of the digital apron tower system display is as follows:

a) Panorama View: Using the camera feed from atop of the control tower, the system offers a panoramic video of the entire control area. It displays aircraft identification and utilizes AR to reveal obscured aircraft. Additionally, the system includes an infrared mode to enhance visibility in low-visibility conditions.

b) Gate View: To monitor gate status, individual cameras are installed at each gate. Rather than displaying all gates simultaneously, the system automatically switches between departure and arrival gates on the display.

c) Digital Twin: The entire area of Incheon Airport is digitized into a digital twin, which provides real-time support for air traffic control tasks.

Panorama view

2.3   By employing stitching technology, the real-time video feed from the cameras is merged to provide a panoramic view of the entire control area.

2.4   Within the Panorama View, essential air traffic control information is seamlessly integrated and displayed. This includes aircraft positions, callsigns and types, as well as gate status, which is indicated using icons and colors. Additionally, the display provides weather conditions, aircraft schedules, and details about restricted areas on the airside.

2.5   Beyond regular real-time video, the system includes an infrared mode. It also utilizes AR technology to project virtual outlines on aircraft, terminals, taxiways, and other airport facilities. This feature allows for precise tracking of aircraft positions, even in obscured or low visibility conditions, ensuring accurate situational awareness.

2.6   The system employs pan-tilt-zoom cameras to swiftly zoom in and automatically track aircraft that need ongoing observation. This advanced feature, which enhances the interface over manual binoculars or CCTV, significantly reduces the workload for air traffic controllers.

Gate view

2.7   To monitor the operational status of the gate, the system provides video feeds from the individual gate camera. Rather than displaying all gates simultaneously, it automatically switches to display the relevant departure or arrival gate as needed.

2.8   The system shows general information, including gate number and aircraft types, along with operational details like departure and arrival schedules and occupancy status. It overlays TSAT, TOBT, and TTOT data, giving air traffic controllers quick access to A-CDM information.

2.9   Using AI video recognition, the system identifies all objects within the gate area, such as boarding bridges, towing vehicles, and ground handling personnel. It correlates this data with aircraft movements, providing air traffic controllers with crucial details like departure readiness and arrival preparedness.

2.10   The system individually identifies all ground service equipment and displays the current status of ground operations. In the future, this data will be integrated with A-CDM to enhance the on-time performance of aircraft.

ATC Assistance Tool

2.11   The system transcribes communications between air traffic controllers and pilots into text and displays it on the screen. Additionally, if there are any errors in the pilot's read-back, it alerts the air traffic controllers to prevent potential miscommunication.

2.12   The system monitors the Hot-spot areas where aircraft and Ground Service Equipment (GSE) roads intersect. If a potential collision between aircraft and ground vehicle is detected, it alerts air traffic controllers to prevent accidents.

Future Directions

2.13   Incheon Airport's digital apron tower system will be implemented in two phases. Phase 1, currently in progress, focuses on establishing the system for the control area of the 2nd Apron Control Tower and is slated for completion by September 2024.

2.14   The phase 2 of Incheon Airport's digital apron tower system involves expanding the system to cover the entire airside, including the control area of the 1st Apron Control Tower and the maneuvering area. This phase aims to introduce additional functionalities, such as detecting runway incursions and monitoring runway occupancy.

2.15   Based on the operational experience of the digital apron tower system, Incheon Airport is considering implementing a fully digital remote tower for the Terminal 3 area, instead of building a new physical control tower, as part of the ongoing master plan.

3.   ACTION BY THE MEETING

3.1   The meeting is invited to:

a)   Note the information contained in this paper;

b)   Note the benefits and challenges of integrating digital apron tower system in to existing airport control towers;

c)   Exchange insights on best practices and experiences from other airports that have adopted similar systems; and

d)   Explore the feasibility of expanding digital apron tower systems to other areas of airport operations.

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