HOW AUTOMATION REVOLUTION AIRPORT OPERATION AND CAPACITY IN POST COVID-19 PERIOD. A CASE STUDY ON ANKARA ESENBOGA AIRPORT

Author[1]: Shabbir Hussain, Author[2]: Hamza Jabbar, Author[3]: Haroon Shehzad, Author[4]: Ahmed Abdulkadir Aden

[1] *Author Supervisor, Aviation Management, Superior University, Punjab, Pakistan*
[2] *Author Student, Aviation Management, Superior University, Punjab, Pakistan*
[3] *Author Designation, Aviation Management, Superior University, Punjab, Pakistan*
[4] *Author Designation, Aviation Management, Superior University, Punjab, Pakistan*

Abstract

Today, air transport is one of the most widely used means of transportation for high-speed transportation and freight. After this speed, endless technological advances, and change are made. Airlines, airport, and air traffic control systems, which are sub-air transport systems, are also experiencing these changes on a daily basis. However, the outbreak of COVID-19 hit hard airports - which could halt developments in emerging markets. As a result, air travel has dropped dramatically, causing airlines to reduce their volume. Many have been shut down by the government to prevent the spread of the virus. The result is a sharp decline in revenue. Given the importance of airports in the economic development of cities, countries, and regions, the overall impact of COVID-19 on the global economy is enormous. The adoption of touch less technologies at airports has increased the pre-epidemic epidemic and is now much faster in recovery time due to your infection control benefits in reducing the spread of the virus. According to the World Health Organization, hand-to-hand transmission is a major cause of viral infections. Compared to manual operation that requires hand-to-hand contact, untouched technology eliminates the contact area, reducing the chance of possible viral transmission. It is all about reducing contact between passengers and airport staff and eliminating the physical action of touching the area where the virus may be present.

In this study, it aims to evaluate the pre- and post-COVID-19 service times and the flow of passengers at the airport in the airline, which is one of the sub-systems of air transport by adding automation systems, in a variety of contexts. Those conditions were adjusted in accordance with IATA standards for LoS and the estimated performance of independent systems. Those scenarios were modelled through the simulation program, assuming a change in the rates of use of the independent system before and after COVID-19. Also, those comparisons reflect the future impact and importance of automation systems on airport terminal flow by comparing the situation before and after COVID-19, with the assumption that the use of automation systems will increase in the post-COVID-19 system.

Introduction

Transportation is severely affected by the COVID-19 epidemic. The virus began to spread by airplane, with almost all countries setting travel restrictions. Demand for airline passengers has dropped by 70 to 95% since

March 2020. The decline in flights due to the closure of many airports has been a major factor in the history of aviation. Demand for air travel, especially in the area of tourism and recreation, has declined sharply during the COVID-19 epidemic. During the current COVID-19 epidemic, air travel has greatly affected the EU region and other parts of the world. Many countries have closed their borders or enforced strict travel laws. Due to restrictions on destination countries requiring solitary confinement, passengers are not allowed to travel, or are barred from traveling.

Currently, air travel is limited to business travel in these epidemic conditions. If the economy and other social activities continue, air transport will be needed. Therefore, it is now important for airlines to ensure the well-being of passengers. Due to the current crisis of COVID-19, the aviation industry should quickly adapt to this new situation. Many large airlines have seen significant reductions in passenger demand due to global travel disruptions, so they are trying a variety of faster and more efficient means of survival as the problem continues worldwide. In addition, new boarding and lending procedures have been implemented, as well as disinfection procedures for aircraft to contain the virus. Over the past decade, many airlines have begun offering pre-flight tests, such as body temperature tests and rapid blood clotting tests, known as COVID-19 tests. However, these are only temporary solutions. For a permanent solution, technical applications must be used. Due to the expected increase in health and safety measures at airports, technology will play a key role in making the processes smoother.

The combination of biometrics, interactive navigation, and performance intelligence provides the most secure and uninterrupted identification and verification. Airports that have experienced car crashes for a long time due to COVID-19 are also expected to use new technologies to help improve their financial health and performance. Due to the COVID-19 epidemic, airports around the world are working to keep passengers safe. Some airports use new technologies in toilets that limit physical contact with devices. Given the critical role of rapid testing and the introduction of new technologies to airport efficiency, it is safe to say that airports around the world will undergo major changes in the coming years. Consider, for example, that future biometric technology at an airport is booming, and regular airline tickets, passports, and passports are being replaced by face recognition technology.

Airports universally are as of now encountering a phenomenal test, as airlines have grounded aircraft in light of the sharp decline sought after. A few airports have fundamentally restricted their tasks, while others have shut through and through, anticipating traffic to get steadily. Throughout the next few weeks, we will distribute a progression of articles with an emphasis on the difficulties looked by the airport functional organizer, as traffic inclines up with the facilitating of travel limitations and on the most proficient method to best deal with these difficulties.

The adjustment of the way of behaving of passengers following the COVID-19 crisis, travel limitations and the following economic crisis have brought about an emotional drop popular for airline administrations. As per IATA, passenger air transport estimated as income passenger kilometre was down 90% year-on-year in April 2020 yet down 75% in August. The breakdown in economic action and exchange impacted cargo, which was practically 30% lower year-on-year in April despite everything around 12% lower in August.

In any case, there is no question that travellers and industry partners the same are anxious to continue traveling. Numerous buyer feeling reviews led in mid-2021 demonstrated customers were encountering "get-away hardship." Combined with an upsurge in trust in air travel given by expanded immunization rates and wellbeing measures, this drive would support the affinity for air travel and would assist with powering the business' recuperation.

Literature Review

Notwithstanding this development in the present innovative advancement of air transport, it is viewed as an extraordinary jump happened. The idea of robotics and the web of things are the ideas that we experience more in our regular routines. In this context, an increment has been seen in the quantity of machines speaking with one another. Emmerson (2010) assessed in his review that by 2020, roughly 50 million machines will be in correspondence with one another. In this context, today, clever transportation frameworks (ITS) show up as cutting edge applications that intend to offer creative types of assistance connected with various transportation modes and stream the board, without typifying insight, and that empower different clients to be better educated and become more secure, more planned and 'more astute' (Chowdhury, 2017). The COVID-19 pandemic, which entered our lives somewhat recently of 2019, has likewise arisen as an element influencing the air transport area and subsequently airport subsystems. COVID-19 disease is a scourge disease brought about by a newfound

Covid (WHO, 2020). Assuming we look at airports as focuses utilized by individuals for transportation administrations, we can say that COVID-19 disease presents more serious dangers in such bustling focuses.

In this context, the most genuine measures taken in airport tasks since the September 11 assaults, inside the extent of the actions taken by the International Civil Aviation Organization with the DOC 10144 distribution, have started to enter air transport (Rosario and Patricio, 2020). This study intends to design a Robotic and IoT incorporated traveller stream framework to limit the lines at the airport in the battle against COVID-19 by utilizing robotics and IoT advancements more successfully in the creating and steadily developing aeronautics area and to mimic how compelling may be these frameworks are in the post-COVID-19 period.

The presentation of an airport is determined by efficient land-and airside operations. For instance, restricted runway or cover limit influences operations, as do limitations on security or identification control. The aircraft circle back is the connection between aircraft and passenger directions. Deviations (disturbances) on either side can prompt postponements, and these can prompt further, flowing impacts on the air transportation network. In this way, airlines ought to think about coupled improvement of the airport (ground) and flight operations in their flight arranging (Rosenow and Schultz 2018). In crafted by Zografos et al. (2013), a tool for total airport operations the executives was created. They considered airside (runways, covers) and landside (registration, security, entryway relax) components and gave a choice emotionally supportive network to key, tactical, and operational situations. The tool was validated through contextual investigations ending up a decent estimate of reality and a decent tool for the end goal of arranging. Scala et al. (2020), Scala et al. (2021) zeroed in on the incorporation of airspace promotion ground airport operations where they upgraded the aircraft arrival succession as well as the limit of the ground (runway, runway, and terminals).

The COVID-19 pandemic guidelines require adjusted taking care of procedures, which infer new operational challenges. In the article of Choi (2021), the effect of COVID-19 on the operations inside airport terminals has been evaluated according to an economical perspective. The creators featured that the increment of passenger staying time can increment existing buyer's spending instead of make new purchasers. They called attention to the requirement for an adjustment of sales technique. Schultz and Fichte (2020) fostered a model for evaluating the transmission risk in the aircraft lodge, which was applied to advance passenger bunch (e.g., families, couples) boarding (Schultz and Soolaki 2021). The outcomes showed a decrease of loading up time by around 60% and less transmission risk (diminished by 85%) contrasted with the COVID-19 standard loading up, in this way, adding to approach to-normal activity progress. In crafted by Kierzkowski and Kisiel (2020) the security control operations were displayed to evaluate the effect of social removing.

Although IoT and robotic technologies are experienced in numerous areas of our lives today, it has been determined by some investigates (Alice, Spencer, etc.) that individuals approach these technologies with a certain faltering.

In their study, Joosse and Evers (2017) interviewed 13 of the passengers, because of their encounters, in the trials they directed with the cooperation of 16 passengers with the "Spencer" robot at one of the most jam-packed airports on the planet. According to the aftereffects of the interview, 12 of the 13 passengers who took part in the study stated that they were happy with the work that the airport administrators did. In the study, examinations were made under three main headings and these are the speed of the robot, the target client bunch, and the general way of behaving of the robot, separately. Regarding the speed of the robot, 3 of the members stated that they could find the robot in the non-dense pieces of the terminal building and 5 stated that the robot was exceptionally quick. A portion of the members stated that they didn't require the direction of the robot since they had utilized the airport previously and knew it. Another issue is stated regarding the general driving and use of the robot. Since the robot works altogether through sensors, it frequently would in general stop when drawn nearer. Members stated that the robot ought to be outfitted with more grounded dynamic abilities to serve especially passengers under time tension in such areas. Then again, they reasoned that robots can be utilized actually in the depiction of different areas for passengers who don't have a clue about the airport terminal.

Triebel, et al, (2016) also displayed in their study that the Spencer robot can approach and interact with an individual, take a target position, and direct the individual or gathering to the target while following individuals beneath. At the point when it realizes that passengers are done following or detects a disappointment, it stops and sits tight for consultation. Empowered by these outcomes, the stage is wanted to be first sent at Schiphol airport quickly. What's more, the "Airstar" robot was planned by LG hardware at the Seoul Incheon Airport terminal, providing consultancy administrations to passengers, trial studies were done (FTE, 2018).

The robot named "Rada" utilized in the Delphi airport terminal 3 building can give information about terminal offices, take-off doors, destination weather patterns, real-time flight status, and the airline's items and administrations. Greets clients and interacts with them using fundamental hand motions and can move around

the hall in predefined ways (FTE, 2018). As of late, Rotterdam The Hague Airport has also tried independent stuff handling robots. Their robots worked behind the scenes, manually holding the sacks of passengers dropped off at check-in.

The airport says it will intently follow robotic technologies to test whether robots can convey stuff quicker than ebb and flow methods and to look for less harmed things (Temblador, 2018) Kansai Airport has explored different avenues regarding "Kate", a savvy check-in stand that can be transported independently to occupied areas at the airport if necessary. A 1-month trial was directed at Kansai Airport Terminal 1 building for the passengers of Air France, Air China, Cathay Pacific Airways, Japan Airlines, Korean Air, KLM, All Nippon Airways, Asiana Airlines, and United Airlines. The point of the trials is stated as detecting the areas with high thickness at the airports and making check-in methodology to diminish the densities by moving the independent frameworks to these areas (Wan, 2018).

The utilization of independent robots, which act according to the airport thickness zone, for check-in purposes proposed in this study, shows a comparability with the "Kate" project tried at Kansai airport.

Table 1 Check-in Simulation Modeling Studies in the Literature

Author	Purpose	Result
Bevilacqua & Ciarapica, 2010	Improved performance	Queuing times are shortened.
Marintseva, 2014	Reducing the check-in queue	Reduction in passenger waiting times occurred.
Mota, 2015	Reducing passenger waiting time and increasing service quality	Passenger waiting times have decreased and service quality has increased.
Al-Sultan, 2018	Maximizing service quality and reducing operational costs	Passenger service quality is optimized with 15 different scenarios.
Bolat & Ateş, 2020	Determining the impact of COVID-19 applications on check-in queues	Check-in queue and service time increased.

The basic elements of the model proposed and simulated in this study comprises of internet technologies,machine learning, the internet of things, biometric and robotic frameworks. By the assistance of these technologies, amore viable and effective terminal stream is focused on the airport terminal.

Research Problem and Methodology

Airport managements are using simulation programs by constructing different scenarios for capacity and flow calculations (Hafner, 2019; Landau, et al., 2015). In this study, two different scenarios will be focused on how autonomous systems that will be be used at Ankara Esenboga Airport affect the check-in flow. The hypothetical values will be simulated with the ARENA simulation program.

In this study, autonomous check-in devices at different rates and the flows and queue formations of passengers with different characteristics will be examined with the ARENA simulation program. In addition, they will be used in the simulation assuming that autonomous check-in devices can reduce queue formations due to their high processing speed and mobility.

The aim of this study to reveal the change in airport check-in queues and processing times due to autonomous check-in devices. In this context, it will be assumed that autonomous systems are performed faster than face-to-face check-in.

Assumptions about check-in desks in this study will be the following:

- It will be assumed that the waiting times at the check-in desks are distributed according to a triangular distribution.
- The use of check-in desks will be assumed to be 60% in pre-COVID-19 check-in procedures.

- The use of check-in desks after COVID-19 will be assumed to be 30%.
- The rate of passengers who do not deliver luggage and do online check-in will be assumed to be 10%.

Assumptions about autonomous systems in the study will be the following:

- It will be assumed that autonomous systems process faster than normal check-in desks and self-service check-in systems.
- It will be assumed that waiting times in autonomous systems are distributed according to a triangular distribution.
- It will shows a triangular distribution in the form of waiting times (1, 2, and 4) in autonomous systems.
- The rate of use of autonomous systems before COVID-19 will be assumed to be 30%.
- The rate of use of autonomous systems after COVID-19 will be assumed to be 60%.
- The rate of passengers who do not deliver luggage and do online check-in will be assumed to be 10%.

Accompanied by these assumptions, the following hypotheses will be created and tested in the study

H1: In the post-COVID-19 period, autonomous systems will reduce the processing time per passenger in airport check-in.

H2: In the post-COVID-19 period, autonomous systems will reduce the total waiting time of passengers in queues at airport check-in and check-in.

Simulation Model Analysis

Ankara Esenboga Airport check-in operations will be simulated with different usage rates in the pre-and post COVID period within the scope of autonomous devices and check-in desks. Within the scope of current IATA data, airport check-in procedures will be simulated by the ARENA simulation program (Figure 1 and Figure 2).

Check-in processes will be examined in 2 scenarios as pre-COVID and post-COVID. In the first scenario, a pre-COVID intensive face-to-face check-in scenario will be simulated. In the second scenario, it will be thought that face to-face check-in transactions, which will be supposed to decrease in the post-COVID period, will be carried out more intensively by contactless autonomous systems.

According to IATA LoS standards, it was stated that the transactions at the check-in desks take between 1-10 minutes in pre-COVID check-in processes. On the other side, it will be stated that autonomous systems perform check-in processes between 0-5 minutes (IATA, 2014). In the scenarios, it will be assumed that the number of autonomous systems, check-in desks, and personnel used in the pre-and post-COVID period are not change. The results from the scenarios will be detailed in the findings and analysis section.

Figure 1. Pre-COVID-19 Check-in Process Simulation

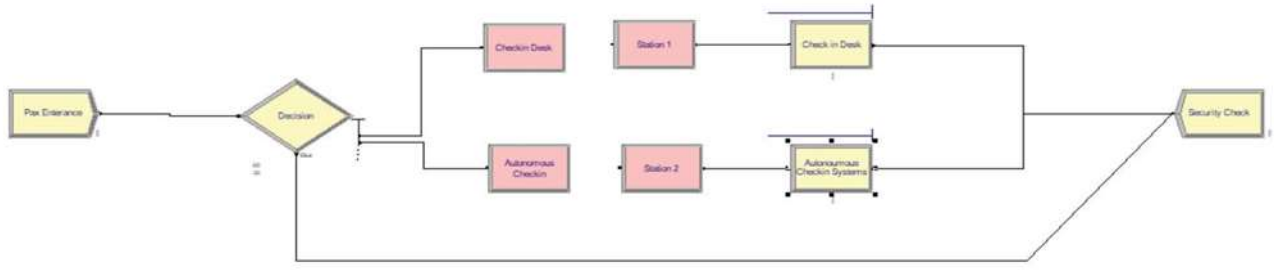
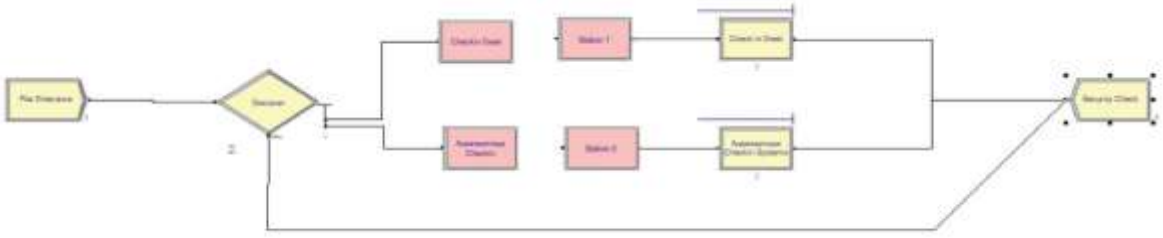


Figure 2.

Post-COVID-19 Check-in Process Simulation



When both scenarios pre and post COVID are examined, it is found out that the increase in the use of autonomous systems with the assumption that face-to-face transactions have been decreased in the post-COVID period will brought about changes in the transaction and waiting times. When we observer all research data, we found out the following results:

- When the check-in process is compared, it is seen that the processing time per passenger has been decreased by 14% on average in the post-COVID period,
- The waiting time of the passengers during the transaction has been reduced by 1%,
- The average total waiting time of passengers is decreased by 56.9%,
- Maximum waiting times of passengers is decreased by 70.5%.

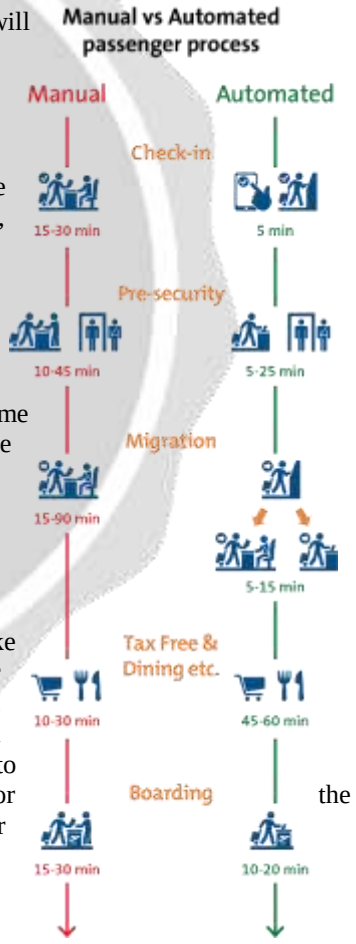
Discussion and Results

Manual Vs Automated passenger process

The most effective way of improving passage efficiency, reducing queuing and increasing traveller satisfaction will lies in passenger process automation.

When we look into the entire passenger process, including all touchpoints and the potential for reducing queuing time is significant. The passenger benefit of this process is two-fold:

1. As queuing is being minimised , As a result passenger frustration will decrease
2. This time can instead be spent shopping, working or relaxing which altogether improving the passenger experience



On the other hand while manual passenger processing, anywhere between one to three hours can be spent by passengers in negotiating check-in, pre-security, migration and boarding controls.

As a result of automation, queuing time at airport checkpoints is being reduced by up to 50%

Airline and airport operators will also benefit from minimising queuing as delayed departures due to queues decrease correspondingly. With boarding time halved, now airports will increase their offering for new routes and departure slots, and airlines will improve their on-time departure performance.

Re-defining the air passenger journey

Now it is focused on how airports are implementing touchless technologies like face recognition and thermal sensing for a seamless, hygienic customer experience. Like Delta Airport is fully biometric terminal that 87% of all outbound Delta international passengers are boarding with their face only at an average verification speed of 1.5 seconds per passenger, it allowing Delta to shorten the usual boarding time process. The benefit of this biometric system for passenger is that once enrolled they no longer need to show their passport or boarding pass at the airport.

The electronic bag tag system

This unique product will allows passengers to check-in and tag bags securely away from the airport for the first time, and by completing the digital transformation of the check-in process.

It will eliminates the negative passenger experience of them checking-in online from their smart phone or tablet, and by receiving digital boarding passes, It was frustrating to still join long queues at the airport to complete your baggage check in process.

Using eTag, the on line check-in process will be extended via the airline's App to include bags. Passengers will now arrive at the airport with both their boarding pass and their bags tagged with the smart two sided eTag, will ready to be dropped off at departures – in a small fraction of the time.

By Check and tag your bags at home with the electronic bag tag and arrive at the airport to get ready to fly.

- You can check-in and tag bags at home with the airline App
- Now you can arrive at the airport with your boarding pass and your bags checked-in and tagged
- You will simply drop bags and go straight to security
- E-Tag will notifies passenger when bag is on the belt

The airport experience will going to be very different in the wake of COVID-19, passengers will have required to socially distance themselves from other passengers, new airport systems and checks will now being introduced and the time spent at the airport may increase.

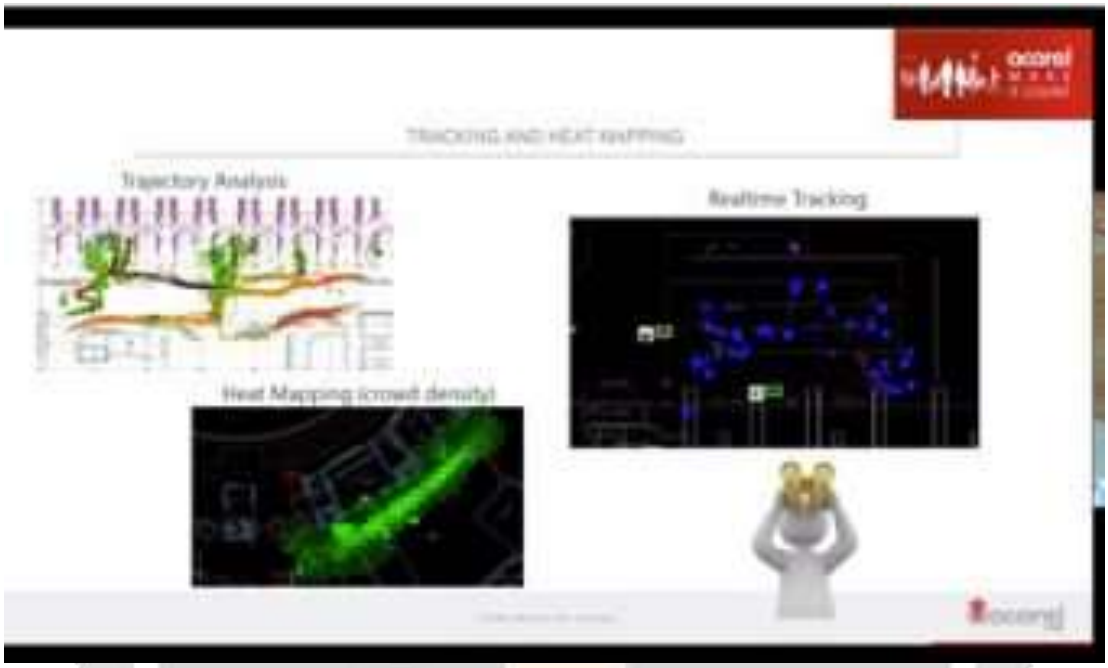
As an industry we have need to find new imaginative, but safe, ways of reducing contact points during the passenger journey, without introducing yet more delays. ETag will facilitate all contactless with staff and machines during the entire baggage check-in process.

- E-Tag will facilitate social distancing by reducing or even removing the check -in queues and the multiple human or machine interfaces. The passenger will only interacts with their own hardware during the entire check-in process
- E-Tag will provide the ability to complete the offsite check-in process, and also allowing the passenger to arrive at the airport with their bags checked-in and tagged. During Check in, a simple drop off point will weigh the bags of passenger before insertion into the baggage handling system
- eTag will be aligned and supportive of the AOC and IATA joint approach to safely restarting the economically vital airline industry
- eTag will meets IATA's track and trace objectives defined by Resolution 753

Automatic Passenger Counting Solutions

It is a leading automated passenger analytics and insights. It is video-based movement tracking software shows what is happening to an entire passenger population, in real time. It allows airports to act decisively to increase efficiency and profitability while improving their passengers' experience.

This passenger analytics solution processes live video input from LiDAR sensors and optical cameras. The system can performs passenger counting, queue analysis, and analyses passenger flow using sophisticated AI techniques. It outputs live passenger data encompassing everything from flows, queues and wait times to processing times, occupancy, and asset utilization.

It 

has the state-of-the-art dashboards reveal actionable insights to improve real-time operations. Accumulated historical data will provides reliable evidence for planning and investment decisions.

Airports of all sizes can use queue analysis to improve checkpoint efficiency. By reducing queue length and waiting time, airports will process passengers into retail areas more quickly. Airports also can use tracking capabilities to understand how passengers move around retail and food/beverage areas. In this way gets understanding dwell times and retail conversion metrics, airports will optimize the value of their retail space.

Infection Detection & Containment System (IDCS) for Airports

It is a real-time thermal monitoring of people to detect and monitor the spread of infections inside buildings and facilities especially at airports.

The application will combines thermal cameras, flight information, passenger flows, and real-time communication to instantly detect passengers having high temperatures and alert airport operations control to identify potentially contaminated areas. The system will also allow airport managers to dynamically redirect passenger flows, reposition flights and reallocate staff, based on capacity needs.

Benefits

- IDCS will supports airports coming back to efficient operation.
- The system will helps to ensure a safe passenger journey.
- In case of an incident, IDCS will allows for fast reaction times and instant prediction of consequences for containment measures.
- In case of an incident, IDCS will allows for fast reaction times and instant prediction of consequences for containment measures.
- IDCS will helps airports sustainably prepare for future pandemic situations.
- IDCS will helps to save costs in the long run without manual staff to be quipped at each sensor.

Conclusion

COVID have triggered the implementation of more touchless solutions, achieving what it could had to achieve in months, things that would have taken two to three years. Automation and touchless technology is increasing the efficiency of passenger flows to allow seamless, fluid and user-intuitive passage, reduce queues and congestion and it also ensures airport staff are directed to where they are needed most. Sanitisation and social distancing are cause of having contactless processes installed at key passenger touch points.

Automatic sensors, computer learning, and individual algorithms are being used in conjunction to perform the seamless process of a user moving through the access point without ever needing to touch a surface. These systems can also ensure that social distancing is adhered to, and that a user will occupies the lane alone, without fear of congestion around the access point.

After the 2021 and beyond, passengers are experiencing more self-service options at airports, including the use of e-gates and biometrics to reduce human contact. Although these are primarily created to speed up processing, they will be extremely useful in the future to reduce queue length and also will monitor the number of people standing near each other during the screening process. The use of facial recognition as part of COVID-19 screening systems will also help to fasten check in process.

The current global situation is changing future mentalities and generate wider acceptance despite previous resistance to biometrics. There will also other technologies that will not use face recognition and biometrics, such as stereo vision sensors, that utilize machine learning and AI which will still help with physical distancing and managing operations in a touch-free environment.

References

- Bolat, E., & Ateş, S. S. (2020). Post COVID-19 precautions management in small-scale airports: Evaluation of check-in process in Erkilet airport by simulation. *Journal of Airline and Airport Management*, *10*(2), 77. https://doi.org/10.3926/jairm.166

- Ayvaz, E. E., Üniversitesi, E., & Ateş, S. S. (n.d.). *THE USE OF AUTONOMOUS TECHNOLOGIES IN AİRPORT CHECK-IN PASSENGER FLOW PRE AND POST COVID-19 PROCESS: THE CASE OF ANKARA ESENBOGA AIRPORT Electronic Flight Bag in the Operation of Airline Companies: Application in Turkey View project*. https://www.researchgate.net/publication/357866861

- Choi, J. H. (2021). Changes in airport operating procedures and implications for airport strategies post-COVID-19. *Journal of Air Transport Management*, *94*. https://doi.org/10.1016/j.jairtraman.2021.102065

- *IMPACT ASSESSMENT OF COVID-19 MEASURES ON AIRPORT OPERATIONS & CAPACITY*. (n.d.). www.arc.de

- Schultz, M., Luo, M., Lubig, D., Mota, M. M., & Scala, P. (2021). Covid-19-Related Challenges for New Normality in Airport Terminal Operations. *Proceedings - Winter Simulation Conference*, *2021-December*. https://doi.org/10.1109/WSC52266.2021.9715417

- *Economic Impacts of COVID-19 on Civil Aviation*. (n.d.). Retrieved April 18, 2022, from https://www.icao.int/sustainability/Pages/Economic-Impacts-of-COVID-19.aspx

- *Fast Travel | eTag, the Electronic Bag Tag, CHECK YOUR BAGS IN AT HOME. BYPASS THE QUEUES!* (n.d.). Retrieved April 18, 2022, from https://www.electronicbagtag.com/

- *After COVID-19: Long-term solutions for airport passenger experience - ACI Insights*. (n.d.). Retrieved April 18, 2022, from https://blog.aci.aero/after-covid-19-long-term-solutions-for-airport-passenger-experience/

- *12 tech solutions for a post-COVID-19 airport experience*. (n.d.). Retrieved April 18, 2022, from https://www.futuretravelexperience.com/2020/05/12-tech-solutions-for-a-post-covid-19-airport-experience/

- *Why Automation Is Key to Airport Efficiency*. (n.d.). Retrieved April 18, 2022, from https://blog.gunneboentrancecontrol.com/why-automation-is-key-to-airport-efficiency