International Journal of Engineering Applied Sciences and Technology, 2019
Vol. 4, Issue 5, ISSN No. 2455-2143, Pages 508-511
Published Online September 2019 in IJEAST (http://www.ijeast.com)

CASE STUDY OF AUTOMATED BAGGAGE HANDLING IN MODERN TRANSPORTATIONS

Michail Papoutsidakis
Dept. of Industrial Design and Production Engineering,
University of West Attica
Athens, Greece

Aikaterini Sfyroera
Dept. of Industrial Design and Production Engineering,
University of West Attica
Athens, Greece

Abhishek Srivastava
Dept. of Engineering and Technology
Amity University
Noida, India

***Abstract*— Nowadays, the numerous and increasingly complex technological applications that are prevalent in everyday life as well as increasing requirements make the automation sector as an integral part of modern society. The automated systems are making rapid development because of the wide range use of machines that achieve cheaper and higher quality results while reducing manual work. A branch which is directly related to automated storage and transfer control procedures is the aviation sector. In this paper an attempt to present the design and study of a fully automated system, the baggage handling system of Athens International Airport. One of the most well-known places with high risk for terrorist attacks, is on the premises of the airport but also within the same planes. The purpose of this thesis is the control of luggage in order to avoid malicious actions (arms, explosives, illicit drugs), and whether reliable is such a system with security in mind. Also, done research for the sortable and separation of luggage per hour as well as analysis of backup systems in case one of the application fault. Capturing the above results in Greece has not made any formal investigation. More specifically referring to all the stages of the path of a baggage from the moment it is delivered at the counter of the passenger up to be loaded on the plane. Presented in detail the design of such a**

***Keywords*—Airport, luggage, baggage handling system**

I. INTRODUCTION

The basic philosophy of the system is to ensure that the baggage after delivered by the passenger at the airport of any airline, will enter the system and it will be redirected to their final destination, the cabin of the aircraft. This process involves some baggage checks with a view to ensuring the safety of any malevolent or terrorist acts either by arms trafficking illegal substances etc. The above check of baggage should place in the shortest possible time so that even in peak periods to avoid any delay even if the given time there is a failure in any subsystem. This fully automated system is designed in accordance with the requirements of the MTR (Minimum Technical Requirements) and the international design system of airports. The plan of the layout of the system involves 2 halls which each include 2 levels. The plane is on the ground floor for the unloading of baggage by competent workmen and their introduction into wagons which transported to the aircraft. The stream of wagons is done only in one direction to avoid accidents. The second level is elevated and includes belt conveyors where luggage is transported, the motor and some machines from which passes control baggage. Also the design of the system ensures that all luggage meet regulations of IATA (International Aviation and Transport Association) and are within the permissible limits in terms of dimensions and weight. The system can manage all kinds of baggage regardless of their weight and shape. If a baggage exceeds the allowed dimensions is transported via OOG (Out Of Gauge Station) station which is responsible for this type of baggage. Any other luggage which is not suitable for transport in the system used the OOG or someone lift. The system is designed to meet the specifications in accordance with the regulations on noise levels and be able to work with the maximum luggage capacity of IPS indefinitely. [1]

II. SYSTEM LAYOUT

For the luggage of departing the process begins at the check in counters and terminates at the target slides. The above procedure includes an automatic transfer function and baggage control i.e. the sorting. It also includes the early bags concerning luggage have arrived earlier from their flight and must be stored at some point. Still contains lines that baggage entering the system manually for various reasons such as e.g. in case there is a flight transfer. For the correct functioning of the system of two identical systems operate independently in different space with one another that communicate only with two lines in order to have flexibility and to meet all requirements for maximum

International Journal of Engineering Applied Sciences and Technology, 2019
Vol. 4, Issue 5, ISSN No. 2455-2143, Pages 508-511
Published Online September 2019 in IJEAST (http://www.ijeast.com)

performance or in situations damage either in maintenance periods. The above is the intersorter lines. The heart of the system is the Hold Baggage Screening that includes the X-rays machines. [2]

A. Check-in Counters

Includes scales and 3 successive belts. The passenger will place his baggage on the first of the three belts of the weighting system.

There, the baggage is weighted by the scale. The operator is able to read the weight of the baggage in a digital display. The same happens with the passenger, with a second monitor to the other side. Subsequently the operator transfers in the second belt the labeling and the baggage tag IE gets a barcode with the passenger information the destination. In the same belt is controlled and the length, the height and the width of the bag by successive photocells. When is cut the bundles of both photocells, the system appears overlength error. As regards the height there is a bar which marks the maximum amount of baggage. Any baggage in excess of even one of the maximum dimensions is moved manually to the system via OOG (Out Of Gauge). Also, if a bag is fragile, or if it is an animal, then conveyed through elevator OOG. The last belt leads to a long length collective belt which collects luggage from many check in and promotes them at the Central baggage control system. At the end of this belt there is a 90-degree bend where it ends in a downhill belt that enters the system. The passenger area is separated from the BHS by fire shutters doors, one for each block in check. [2]

B. Transfer

The transfer lines are used mainly for baggage which come from another aircraft. Also used to manually placed a bag on the system for various reasons. The system is designed with a Read-Rate around 70% of baggage transfer. All baggage must have tags with a 10-digit barcode according to IATA standards. [2]

C. Sorter

The sorter is the heart of BHS and consists of 200 wagons that are loaded separately from the belts through inductions and handing out luggage at destination chutes with the usage of tilt mechanisms. The luggage is distributed on chutes destinations according to the MTR. All these wagons are connected to one another across the sorter's length until the first wagon to connect to the last closing thus a bronchus. The maximum speed of the sorter is 2m/s and corresponds to 5540 trays/hour. The system efficiency is 95% and the maximum number of luggage per hour compared with the availability of trays. The induction is capable of loading a bag per two trays. The sorter consists of both mechanical and electrical parts. The carrier is the part of transferring the sorter and consists of 2 parts. The frame and tipping mechanism. The framework consists of a metal toggle and 2 vertical shafts where they reside and the wheels. Each axle has 4 wheels, two of them are for horizontal stability while the other two contribute to the vertical stability of the frame. The wheels are made of metal, plastic, hard rubber core and a long-lasting life bearing. A hook and a swivel link connecting one carrier to the other. The tilt mechanism consists of an arm which is connected with the tray and connected to the saddle via a shaft. The saddle slips in plastic bearings and fastening in 3 positions horizontally where and locks and two others of subversion. To unlock the mechanism, it used the diverter who push a piston which in turn exerts a force on the side points of the saddle so overturned the tray. The diverter are firmly established in the system, without moving, what points we need to overturn all the slides and elsewhere as HBS, MES, EBS, intersorter. At this point it should be noted that to revert the tipping mechanism in horizontal position, have to go through some other firmly established mechanisms in the system, named repositioning. [3]

D. Early Bag

The early bag system is designed so that it has the ability to store at least the total amount of Transfer lines and two Transfer at peak time amounting to 288 suitcases. The baggage always stored based on the time departure for each flight and repositioned to the sorter system automatically without instructing someone operator. All EBS luggage checked and then stored without having to check again. These bags are placed on the rows of EBS that are behind the target slides and must be clean from the control. These suitcases never stored at that point unclear or without being checked and this is very important for the security of BHS. [2]

E. Intersorter

The main function of the Intersorter line is the transfer of baggage from one hall to the other. A more basic usage of this line is for backup if there is a problem to a belt. With this way the system doesn't be down and does not minimize the number of baggage which can manage. The main feature of Intersorter-Bags is that the suitcases are intercut with the Check-In-Bags and as a result should be checked again at Level 1 and Level 2. All net luggage from the Level 3 must be marked with some mark or with tape. The fact this benefit in knowing the operator that the baggage has been checked and has come out clean in another hall in order to avoid a second redundant check of luggage. [1]

F. Arrivals

The arrivals include the reclaim belts where passengers get their luggage at the airport. The settings of the reclaim belts follow the IATA and Protocol as regards the length is much larger than that specified by the MTR. For stopping and starting these belts, operators are responsible and only from their own command from

International Journal of Engineering Applied Sciences and Technology, 2019
Vol. 4, Issue 5, ISSN No. 2455-2143, Pages 508-511
Published Online September 2019 in IJEAST (http://www.ijeast.com)

a table with button can start the belt. This process cannot be done remotely with a command only locally. These baggage transported with electric vehicles from the plane and placed manually in the reclaims belts by handlers of each company. [2]

G. Hold Baggage Screening

The inline screening associated with the control of luggage, detecting explosive materials, according to international safety standards. Distinguished in the following levels:

LEVEL 1

Automatically check the luggage of an EDS (Explosive Detection System) X-ray machine. There are 4 control lines. Each has an in-line x-ray machine. The 4 input lines, after the exit of machinery and two are merged into two output lines and therefore two induction. Approximately 70% of the luggage end up clear at this level.

LEVEL 2

This level regards to inspection of the other baggage that is not passed as clear from the level 1. Here the image is sent from the device to a central monitoring room in any of the terminals workstation. The operator must decide if the bag is clear or unclear in the timeframe of 15 sec. This decision is synchronized with the baggage which at this time are directed to the sorter induction. The clear baggage enters to the sorter and end up on chutes while that baggage which remain unclear are driven on level 3 for further testing.

LEVEL 3

At this level checked baggage that have been described as unclear from level 1 and level 2 as well as those marked as mistracked or they have lost their step. This area includes a semi-automatic conveyor system to transport baggage on a CT inline machine. From there the luggage can be characterized as clear, unclear, mistrack. If the bag becomes clear enter to the sorter via level 3 induction.

Fig. 1.

LEVEL 4

As many baggage remain unclear, at this level sent a different type icon to the control room monitoring at another workstation terminal. In this case likewise with the level 2 baggage has time limit to decide the operator if the bag is clear or unclear. If the bag becomes clear enters to the sorter via level 3 induction. If the baggage has become unclear must be re-entered manually in the CT machine. Similarly, the same process is followed as many baggage is mistrack.

LEVEL 5

If the baggage is unable to get into the system then there is a local workstation where the luggage will be scanned by the operator and is called level 5. [1]

H. ATR System

The number of detectable tags that the PLC can manage is only one, so all devices with more than one tags will be qualified as multi tag and will not be able to read. The parameters taken into account for the design of the system are the dimensions and speed of belts, the dimensions of the baggage, the gap between the belts and the features of barcode.

Also very important role plays the tracking zone and the communication with the host. If one of the above subsystems does not work correctly, it can be create problems in the way of good operation of heads. The purpose is to accurately detect the movement of the baggage through a virtual window. This length is related with the requirement of the system to maintain the gap between the bags at 500mm. As a result, the length of the window differs depending on the separate length of each piece of baggage. The window is created by the separation of the luggage before the MVT machine and is controlled by the PLC through the motion of the conveyor belt. This is accomplished through encoder that is below the belt and sends a pulse signal to the generator from which the signal is transferred to the PLC. The measuring device is located in the center of the film for a more accurate measurement. This is because the angular speed of the film differs. On the inner side the angular velocity is less than that of the outer side on a power turn. So to calculate the step of the baggage must be known its exact position on the film. However, because this is not possible and there are many deviations, an average angular velocity value is chosen where it does not greatly affect the accuracy of the tracking. For this reason the encoder wheel is always located in the center of the belt with calculated the average angular speed of the film.

The position of the baggage is defined by the photocells at the beginning, at the end, and along the belt in various places. In these photocells the length of the baggage is defined by the measurement of the number of pulses that the photocell remains jammed. [4]

I. Pack-Track System

PACK-TRACK is the software supported by DATALOGIC Omni-Directional for Reading Stations that allows to read and correctly match the codes in each piece of baggage that is very close to each other.

In fact, in the following example the codes of two or more consecutive bags are located simultaneously in the same scanning area. Therefore, this condition occurs when, given the presence of 2 bags in the specified area, the second baggage code is read first and then the previous baggage code is read. A system without PackTrack could match the code of the second bag to the first and vice versa, thereby causing an error in sorting.

Monitoring is done by the system using a PS photocell and encoder. These badges together give the position of the baggage in the Reading Area. The scanner keeps trying to read. When the scanner reads a bar code, it will assign the encoding to the correct baggage, based on the information regarding its location in the Reading Area. The scanner sends the messages to the host when the baggage reaches the TX data on the transport line.

The data transfer Line (TX DataPosition) is a fictional line that is located after the last useful part of the laser scanning line. When the front or back of the baggage reaches this line, depending on how the system is set (TX Edge Leading or Trailing values), the PackTrack system starts transmitting the barcode read data. Its position can be set in the software as a system parameter and can be set by means of the distance, expressed in mm, by the PS line. If we want the transmission to occur on the front of the baggage (peak), we need to be sure that the baggage has completely abandoned the scan area. In This case we will have to place the data transfer line at a distance greater than or equal to the maximum permissible length for the baggage. There is also an edge mode that takes place when the baggage is already out of the scanning area itself. Since the position of the bar code must be known, the calibration of the PackTrack must be performed on scanners. [4]

III. IMPROVEMENT SUGGESTIONS

At this point it should be noted that to improve the system and reducing the time that an induction out of order, suggested splitting the blocks or transfer belts, or even the intersorter. If an induction is powered by 2 blocks and the CIC intersorter, in case of failure, all the above systems will be inoperative. In case that added an induction, will disable only the induction in which the problem exists and consequently the remaining subsystems will not be affected, continued smooth operation. In addition, some alarms are grouped in a zone and appear as a general alarm. In case of failure, it consumed time unnecessarily until the moment of fault detection and in what subsystem or component belongs. Suggested their separation with different signals and separate commands resulting a more qualified feedback. Also, it should be noted how important role plays the correct system maintenance by specially trained personnel. With the preventive maintenance achieved largely eliminating breakdowns and hence, the increased time of proper function of the system. Besides all the above should be noted how important role plays the Hold Baggage Screening Room, Control system operation. Without this, there is no proper control of luggage. For the above reason, it is proposed to build backup control room in order to maintain proper function in case of an emergency event. Finally, another important factor that helped to maintain good function, is the spare parts warehouse. What is required is a completely up-to-date and functional warehouse which can provide at any time any replacement that finds application in the system. For this reason, it is necessary to have a qualified staff responsible for the management of the warehouse and equipment renewal. To make this possible, a key factor is the updating of staff that manages the location regarding new parts more advanced technologically. The purpose is the continuous progression of the system. For the systems optimization is necessary to keep pace with the technological development that prevails in modern society.

IV. CONCLUSION

It was described the detailed plan of the baggage management system of Athens International Airport. This thesis comprises both an analysis of sub-system and description of how the individual machines make up the system. It was noted how important is the good functioning of all regional systems to ensure proper system performance, with as much less response time.

V. ACKNOWLEDGMENTS

All authors would like to thank the University of West Attica for the financial support provided to them for this research project.

VI. REFERENCES

[1] Aktor Facility Management FDS (8/2010)
[2] Functional Design Specification Abb (6/2015)
[3] Mannesmann Dematic Engineering (2/2017)
[4] ATR operation and reference manuals (8/2016)