



Smart Airport Logistics Box – Luggage Delivery

Capstone 2.0 – Team 5

Date: 7/12/2023

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Elevator Pitch

Saudi Ground Services (SGS) faces a problems with the missing luggage in aerodrome by labors, so this type of problem and industry in need of technological solution that can rely on to solve these issues.



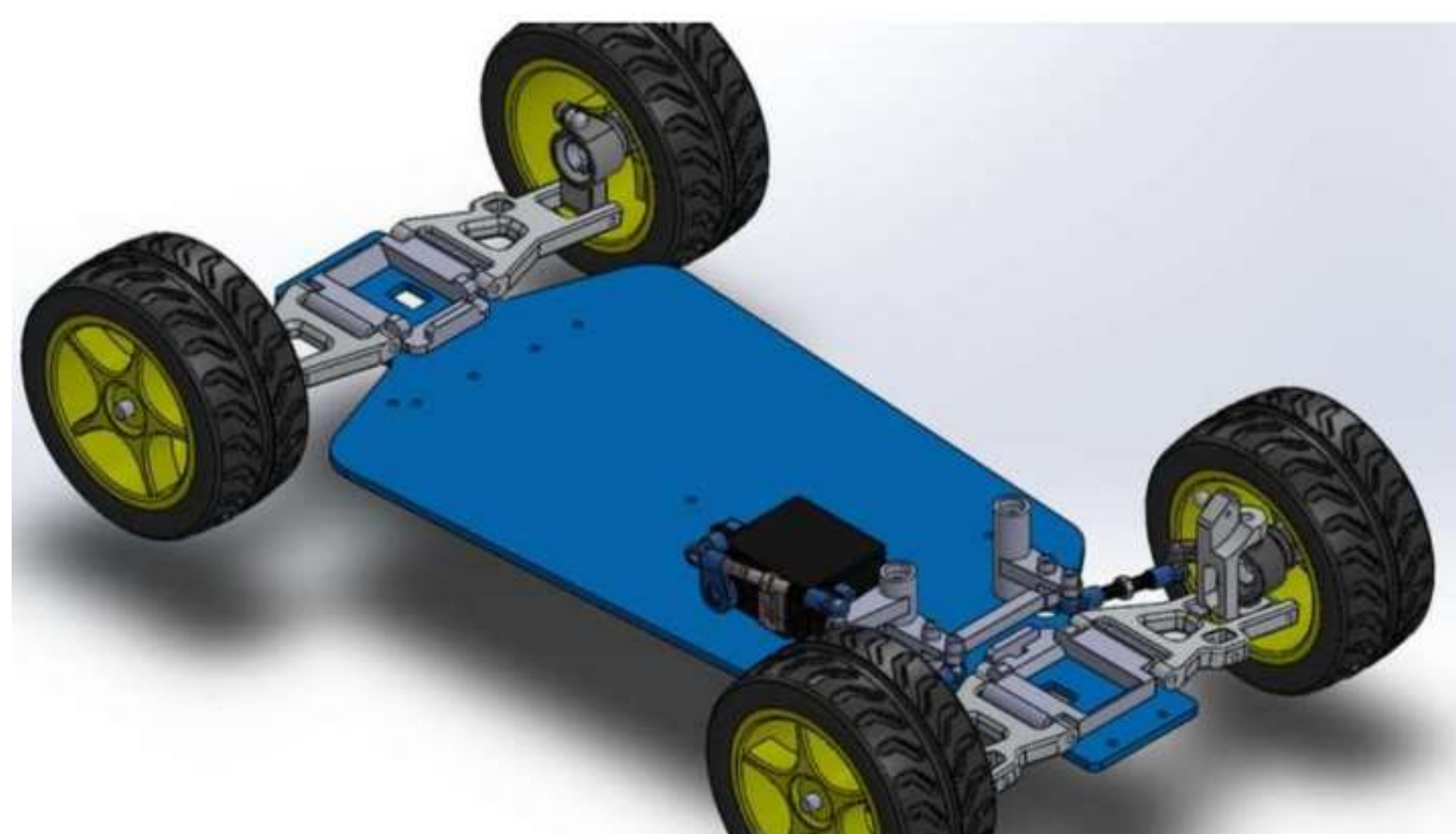
Background

A. Project Statement:

We will develop a Smart Airport Logistic Box that will replace the conventional process of transferring luggage from airport terminals to airplanes that is filled with major challenges and complexities. such as flight take-off delays and instances of misplaced luggage. These problems are primarily caused by the heavily rely on human factors which are susceptible to human error.

B. Specifications

- ❖ The box reduces time by streamlining processes and minimizing delays.
- ❖ It improves accuracy and reduces human errors, ensuring precise operations
- ❖ The box protects luggage from weather conditions, safeguarding its integrity.
- ❖ Maintenance costs are reduced due to the box's reliability and durability.
- ❖ Operations costs are decreased as the Autonomous Box optimizes efficiency.
- ❖ The box consumes low power, contributing to energy efficiency.
- ❖ It is environmentally friendly, incorporating sustainable features.
- ❖ The Autonomous Box helps organize traffic at the aerodrome, enhancing overall efficiency.
- ❖ It is designed for easy storage when not in use, maximizing convenience.



Final Target Specifications

Table: Final Target Specifications					
Metric#	Need#	Metric	Imp out of 5	Unit	Target Value
1	1,8	Time to deliver the luggage	5	min	10 min
2	2,3	Process accuracy	5	%	<95%
3	2,3	Product defect	4	%	>6%
4	4	Maintenance Cost	3	SAR/km	<0.095 SAR/km
5	5	Operational Cost	4	SAR/km	<0.125 SAR/km
6	4,6	Power consumptions	3	Watt. Hour	11.05 Watthour
7	1,8	Distance traveled	4	Meter	2000 Meter
8	9	Volume	4	bags	5 bags

Prototype Development

A. Process accuracy < 95%:

We have chosen two systems that can achieve process accuracy reaching 95%. We used Pixhawk controller with highly efficient GPS and used mission planner we can program the box route accurately. Through mission planer you can easily determine the optimal path or route to achieve the mission's objectives, considering various factors such as terrain, obstacles, and waypoints.



B. No Loud Power Consumption < 12 Watt. Hour:

We have tested our system, and we measured the voltage and current for a single trip which will take 10 min.

C. Luggage defect >6%:

We take meticulous measures to safeguard the integrity of your luggage from start to finish. Here's how we ensure their safety:

- ❖ **Gentle Handling:** Our conveyor belt operates at a slow and seamless pace, guaranteeing a smooth transition of your luggage into the cargo box. This deliberate approach prevents any rough handling that could potentially cause damage or breakage to your bags.
- ❖ **Weather Resilience:** Our cargo boxes are constructed using Aluminum materials. This high-quality material forms a protective shield around your luggage, shielding it from the harshest weather conditions, including heavy rain and snow. Your bags remain secure and sheltered from external elements, ensuring their condition is preserved throughout the journey

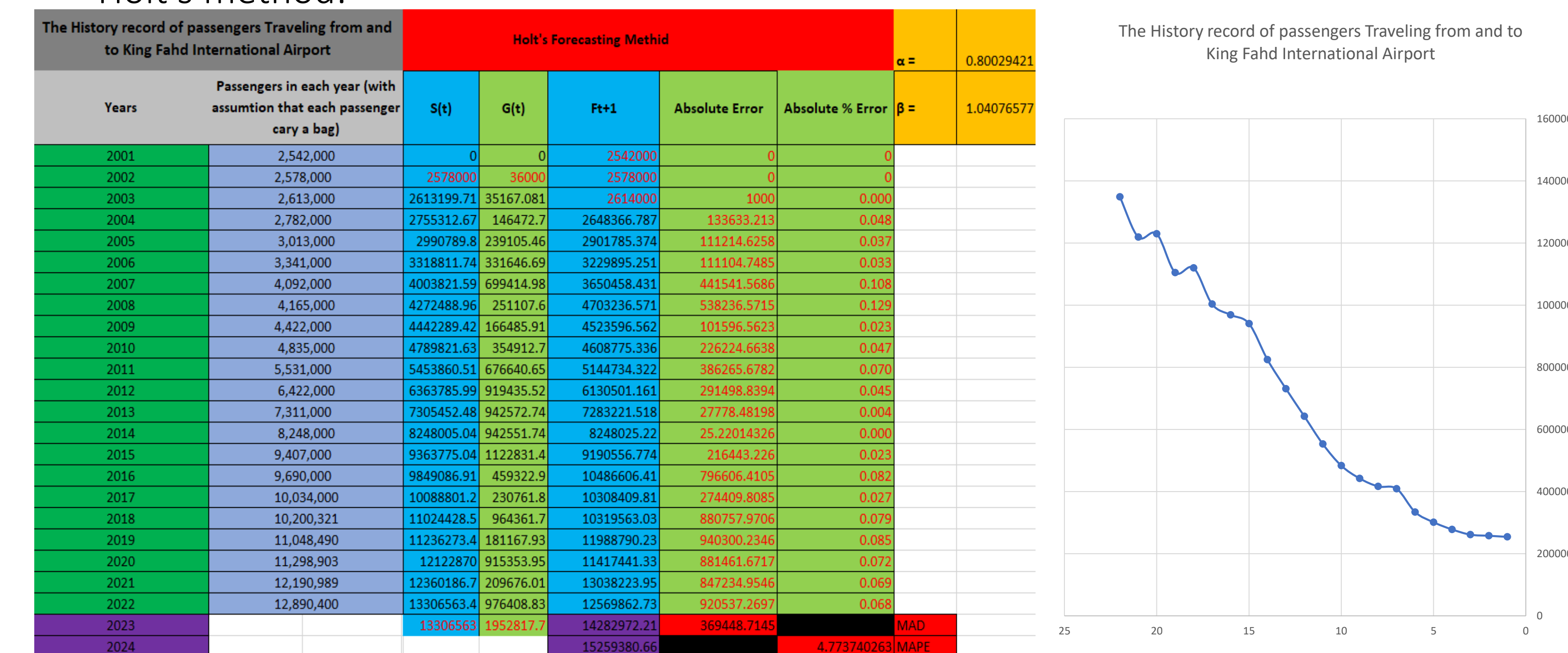
Methodology

Forecasting (Input) + Mathematical Model (processing) = Smart Airport Logistics Box (output)

- ❖ Predict demand: Know exactly how many boxes you need.
- ❖ Cut costs: Minimize wasted storage & unnecessary purchases.
- ❖ Boost efficiency: Streamline operations & improve delivery times.
- ❖ Thrive with data: Make informed decisions & be proactive

Steps

- ❖ Collecting past data about luggage growth for past 22 years & forecasting using Holt's method:



Formulation:

- ❖ Decision variables:

$$X_j = \text{The box needed to serve parking } j \quad \forall j$$

$$Y_{i,j} = \begin{cases} 1, & \text{if the box is assigned from conveyor belt } i \text{ to the parking } j \\ 0, & \text{Otherwise} \end{cases}$$

- ❖ Objective Function:

$$\min Z = \sum_{j=1}^{10} X_j \left(C + \sum_{m=1}^{12} CM * A_m \right)$$

- ❖ Constraints & Parameters:

- $\sum_{j=1}^{10} X_j \geq 1$ CM = Maintenance cost after the box operates for a certain period.
- $\sum_{i=1}^{10} \frac{D_{ij}}{V} * Y_{ij} \leq TD \quad \forall j$ d_{ij} = Distance from location i to j measured in meters. $\forall i, \forall j$
- $\sum_{j=1}^{10} X_j * W_c \geq W$ P = The number of parkings in the Airport.
- $\sum_{j=1}^j Y_{ij} = X_j \quad \forall i$ M = The maximum number of luggage pieces a box can handle.
- $Y_{ij} \in \{0,1\}$ TD = The maximum allowed time for luggage delivery (in minutes).
- $Y_{ij} \in \{0,1\}$ V = The speed of the boxes in meters per minute.
- $Y_{ij} \in \{0,1\}$ W = The total weight of the luggage pieces.
- $Y_{ij} \in \{0,1\}$ C = The cost of purchasing a single box.
- $Y_{ij} \in \{0,1\}$ W_c = The maximum weight capacity of each box.

Conclusion

The revitalization of the field of aviation & logistics was successful in improving the recovery rate from 45% to 56% after COVID-19 Pandemic. With the generation of our project in this field, our Smart Airport Logistics Box will contribute in the improving of this field by using automated features and advanced technology, we ensure efficient, secure delivery while enhancing passenger satisfaction and company needs.